Issued May 1967

SOIL SURVEY
ARENAC COUNTY
Michigan

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
MICHIGAN AGRICULTURAL EXPERIMENT STATION
and
MICHIGAN DEPARTMENT OF CONSERVATION

Major fieldwork for this survey was completed in 1954. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1954. This survey was made cooperatively by the Soil Conservation Service, the Michigan Agricultural Experiment Station, and the Michigan Department of Conservation; it is part of the technical assistance furnished to the Arenac County Soil Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of Arenac County contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the value of tracts of land for agriculture, industry, or recreation.

Locating Soils

All the soils of Arenac County are shown on the detailed map at the back of this report. This map consists of many sheets that are made from aerial photographs. Each sheet is numbered to correspond with numbers shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the report. This guide lists all of the soils of the county in alphabetic order by map symbol. It shows the page where each kind of soil is described, and also the page for the soil management unit, woodland suitability group, or any other group in which the soil has been placed.

Individual colored maps showing the relative suitability or limitations of soils for many specific purposes can be developed by using the soil map and information in the text. Interpretations not included in the text can be developed by grouping the soils according to their suitability or limitations for a particular use. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils in the section that described the soils and in the section that discusses management of the soils for various kinds of crops.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

Engineers and builders will find under "Engineering Uses of the Soils" tables that give engineering descriptions of the soils in the county and that name soil features that affect engineering practices and structures.

Community planners and others concerned with suburban development can read about the soil properties that affect the choice of homesites, industrial sites, schools, and parks in the subsection "Engineering Interpretations," where use of the soils for residential development and recreational uses is discussed.

Scientists and others can read about how the soils were formed and how they are classified in the section "Formation, Classification, and Morphology of Soils."

Students, teachers, and others will find information about soils and their management in various parts of the text, according to their particular interest.

Newcomers in Arenac County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County."

Cover picture: **Sugarbeets on Sims loam in the foreground and rye on Pinconning loamy sand in the background. These crops were selected for planting because of their suitability for these particular soils.**

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NOTICE TO LIBRARIANS

Series year and series number are no longer shown on soil surveys. See explanation on the next page.

Issued May 1967

EXPLANATION

Series Year and Series Number

Series year and number were dropped from all soil surveys sent to the printer after December 31, 1965. Many surveys, however, were then at such advanced stage of printing that it was not feasible to remove series year and number. Consequently, the last issues bearing series year and number will be as follows:

Series 1957, No. 23, Las Vegas and Eldorado Valleys Area, Nev.
Series 1958, No. 34, Grand Traverse County, Mich.
Series 1959, No. 42, Judith Basin Area, Mont.
Series 1960, No. 31, Elbert County, Colo. (Eastern Part)
Series 1961, No. 42, Camden County, N.J.
Series 1962, No. 13, Chicot County, Ark.
Series 1963, No. 1, Tippah County, Miss.

Series numbers will be consecutive in each series year, up to and including the numbers shown in the foregoing list. The soil survey for Tippah County, Miss., will be the last to have a series year and series number.

SOIL SURVEY OF ARENAC COUNTY, MICHIGAN

BY C. E. REDMOND AND C. A. ENGBERG, SOIL CONSERVATION SERVICE, U.S. DEPARTMENT OF AGRICULTURE

FIELDWORK BY W. H. COLBURN, MICHIGAN DEPARTMENT OF CONSERVATION, AND E. P. WHITESIDE, KARL PREGITZER, SIDNEY POLLACK, AND B. L. ALLEN, MICHIGAN AGRICULTURAL EXPERIMENT STATION

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH MICHIGAN AGRICULTURAL EXPERIMENT STATION AND MICHIGAN DEPARTMENT OF CONSERVATION

ARENAC COUNTY is in the eastern part of the Lower Peninsula of Michigan, along the shore of Lake Huron (fig. 1). It has a land area of 235,520 acres or 368 square miles. In 1963 the population of the county was 9,860. Standish, the county seat and largest town, is in the southern part of the county.

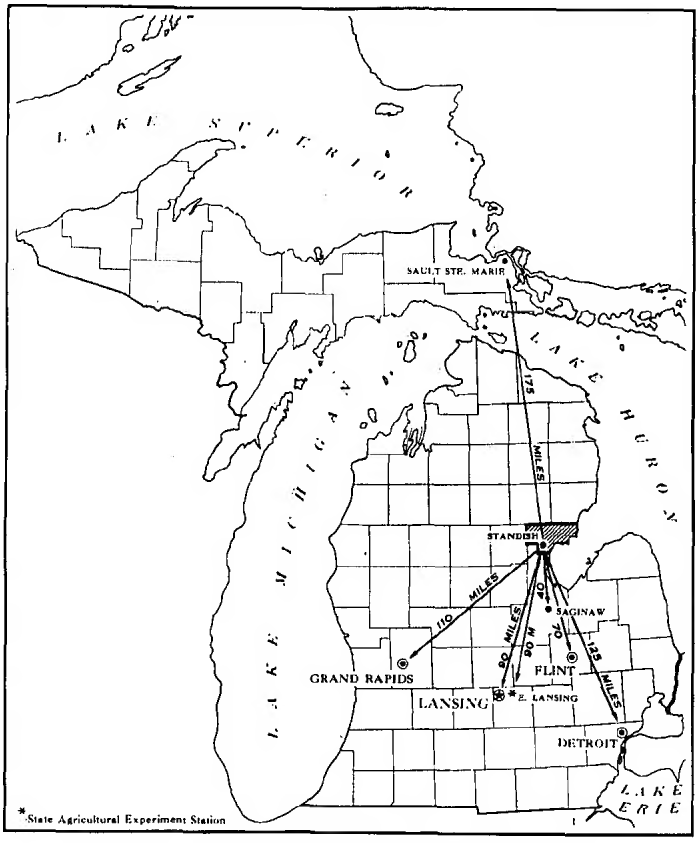

Figure 1.—**Location of Arenac County in Michigan.**

Slightly less than half the area of Arenac County is in farms. Because of the cool temperature, the area is marginal for those crops that are generally grown in the Cornbelt. Agriculture is the principal enterprise, and hay crops, corn, oats, wheat, sugarbeets, and field beans for drying are the principal crops. There are dairy cows or other livestock on most farms. Large areas of the county are wooded. A large acreage in the county is owned by the State of Michigan.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Arenac County, where they are located, and how they can be used. They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many other facts about the soils. They dug or bored many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide uniform procedures. For successful use of this report, it is necessary to know the kinds of soil groupings most used in local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first described and mapped. Au Gres and Deford, for example, are the names of two soil series. The first was named for a village in this county and the second for a school in Clayton Township. All the soils in the United States having the same series name are essentially alike in those characteristics that go with their behavior in the natural landscape. Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Nester fine sandy loam and Nester loam are two soil types in the Nester series. The difference in the texture of their surface layer is apparent from their names.

Some types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Nester fine sandy loam, 2 to 6 percent slopes, is one of several phases of Nester fine sandy loam, a soil type that ranges in slope from nearly level to very steep.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that greatly help in drawing boundaries accurately. The soil map at the back of this report was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed, and so small in size, that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Isabella-Ubly loamy sands, 2 to 6 percent slopes.

Some mapping units contain more than one kind of soil in a pattern more open and less intricate than that of a soil complex. Such a mapping unit is called a soil association. A soil association differs from a soil complex in that its component soils can be mapped separately, at ordinary scales such as 4 inches per mile, if practical advantages make the effort worthwhile. Separate mapping at ordinary scales is not possible for a soil complex. A soil association, like a soil complex is named for the major kinds of soils in it, for example, Au Gres-Roscommon association.

On most soil maps, areas are shown that are so rocky, so shallow, so frequently worked by wind and water, or so wet that they cannot be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Gullied land or Fresh water marsh, and are called miscellaneous land types rather than soils.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil survey reports. On the basis of yield and practice tables and other data, the soil scientists set up trial groups; then they test these groups by further study and by consultation with farmers, agronomists, engineers, and others. Finally, they adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this report shows, in color, the soil associations in Arenac County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The thirteen soil associations in Arenac County are grouped in four main parts, mainly according to texture. In soil associations 1, 2, 3, and 4 are dominantly soils that have a loamy or clayey subsoil. Soils formed in shallow, sandy deposits over loamy or clayey material are in associations 5 and 6. Soils in associations 7, 8, 9, and 10 formed in sandy or loamy material, and those of associations 11, 12, and 13 are from organic deposits, beach sands, and other materials.

1. Nester-Isabella-Kawkawlin-Twining Association

Mainly level to sloping, well-drained to somewhat poorly drained soils from loamy glacial till

This soil association is on level to sloping moraines that in some places between the hills contain closed depressions. Slopes are short and are generally less than 12 percent, but small areas have steep slopes.

The soils in this association formed in material derived from loamy glacial till. They have a subsoil of clay loam and sandy clay loam. In places the material above the subsoil is sand, loamy sand, or sandy loam that ordinarily ranges from 8 to 30 inches in thickness but is as thick as 42 inches in some places. The soil material in the depressions is muck in some places.

This association consists mainly of Nester, Isabella, Kawkawlin, Twining, and Ubly soils, but it also includes minor areas of Brevort, Iosco, and Selkirk soils.

The Nester, Isabella, and Ubly soils, in the sloping areas, are well drained to moderately well drained. Nester soils formed in clay loam and Isabella soils in sandy clay loam. A view of a Nester soil in this association is shown in figure 2. The Ubly soils formed in 18 to 42 inches of sandy loam underlain by loam, clay loam, or sandy clay loam. The Kawkawlin and Twining soils are in level and depressional areas and are somewhat poorly drained, or imperfectly drained, the term that has been used in Michigan. The Kawkawlin soils formed in clay loam, and the Twining soils in sandy clay loam.

The poorly drained Brevort and the somewhat poorly drained Iosco soils formed in 18 to 42 inches of sand or loamy sand, underlain mainly by clay loam but in places by sandy clay loam. The somewhat poorly drained Selkirk soils formed in clay and silty clay.

Although the soils in this association are productive, the somewhat poorly drained soils need artificial drainage before they can be used successfully for crops. Much of the acreage is used for cash grain crops and for dairy farming.

2. Kawkawlin-Twining-Sims Association

Mainly level to gently sloping, somewhat poorly drained to very poorly drained soils from clay loam and sandy clay loam glacial material

This soil association is in level to gently sloping areas that contain a few depressions. Slopes are dominantly less than 2 percent, but in a few places they are more than 6 percent. The depressions are subject to flooding because of runoff from higher lying slopes.

The soils in this association formed in clay loam and sandy clay loam glacial material. In small areas the upper part is sand, loamy sand, or sandy loam that is as much as 42 inches thick in places but is generally less than 30 inches thick.

Dominant in this association are the Kawkawlin, Twining, and Sims soil. Minor areas consist of Iosco, Isabella, Nester, and Menominee soils.

The Kawkawlin and Twining soils, on level plains and in some depressions, are somewhat poorly drained. The Kawkawlin soils formed in clay loam, and the Twining soils in sandy clay loam, both under the influence of a fluctuating water table. The poorly drained to very poorly drained Sims soils formed in like material under the influence of a high water table.

Iosco soils formed under influence of a fluctuating water table on level plains. They consist of sand underlain by sandy clay loam and clay loam at a depth of 18 to 42 inches. On the slopes are the well drained and moderately well drained Nester, Isabella, and Menominee soils. Nester soils formed in clay loam, and Isabella

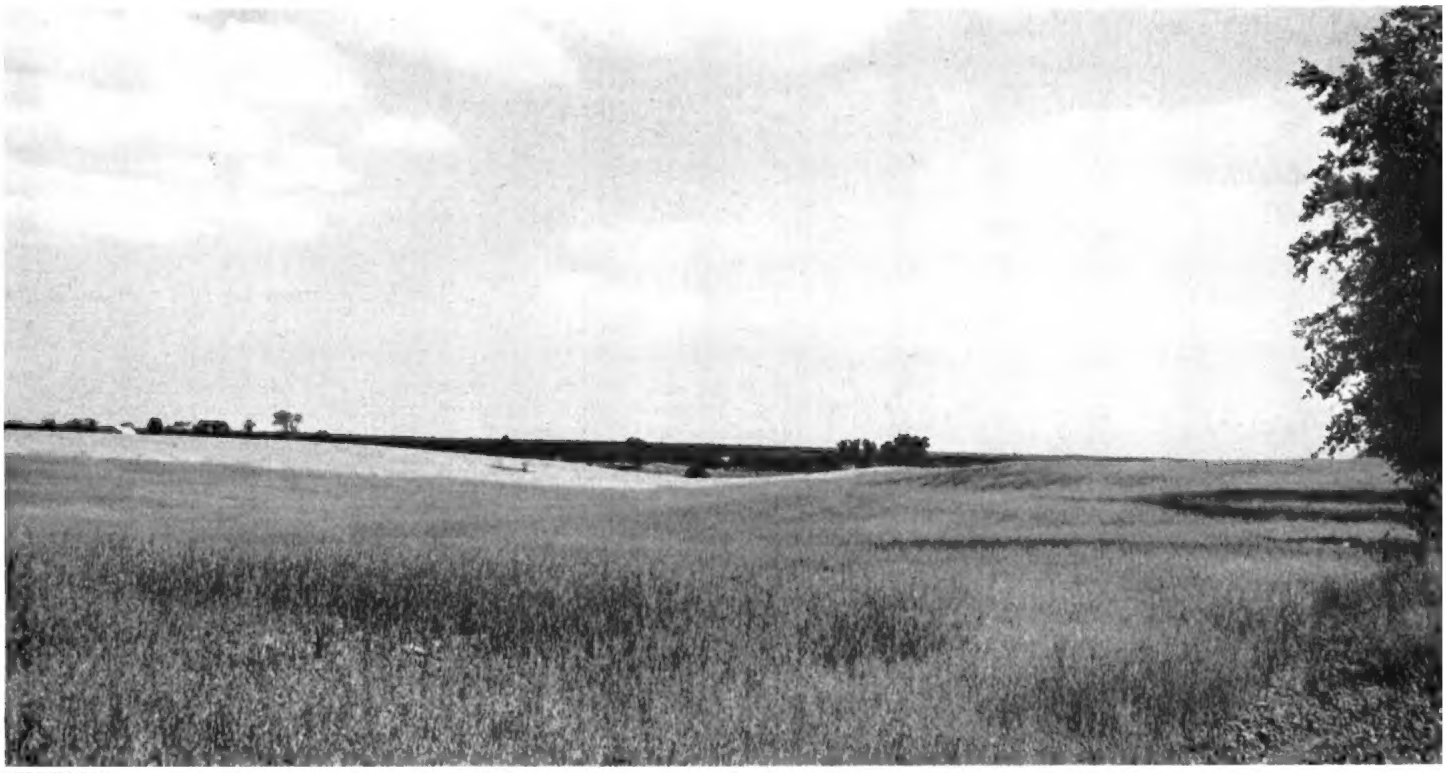

Figure 2.—**Undulating to hilly Nester loam, typical of the Nester-Isabella-Kawkawlin-Twining association.**

soils in sandy clay loam. The Menominee soils are sandy and are underlain by clay loam at a depth of 18 to 42 inches.

The Kawkawlin and Twining soils are wet during some seasons and need artificial drainage before crops can be grown successfully. Nester and Isabella soils are fertile but are subject to moderate water erosion.

In general soils of this association are well suited to crops, but use for woodland, residential areas, or intensive recreational development is somewhat limited. Most areas are in crops or are in trees. Dairy farming is the main enterprise, and much of the acreage on these farms is in forage crops. The acreage in corn is increasing, and yields of this crop are also increasing.

3. Wisner-Sims Association

Level or nearly level, poorly drained and very poorly drained soils formed in clay loam

This soil association is in level or nearly level areas that include some depressions. There are also a few low ridges where the slope is as much as 2 percent in places.

The soils in this association formed from clay loam under the influence of a high water table. In a few small areas there is a thin layer of sand or loamy sand in the upper part.

This association consists mainly of Wisner and Sims soils, but it also includes minor areas of Kawkawlin and Iosco soils. The Wisner soils are limy at or near the surface, but the Sims soils are free of lime to a depth of 10 inches or more. The Kawkawlin and Iosco soils are both somewhat poorly drained. Kawkawlin soils formed in clay loam, but the Iosco formed in sand or loamy sand 18 to 42 inches thick over clay loam.

Soils in this association are productive. All of the crops commonly grown are well suited, and yields are high if the soils are artificially drained. Use of the soils for woodland or for residential or recreational developments is severely limited.

4. Charity-Pickford Association

Level or nearly level, poorly drained and very poorly drained soils formed in clay or silty clay

This soil association is in level or nearly level areas that include some small depressions and low ridges. The soils formed in clay or silty clay under the influence of a high water table. The Charity soils are limy at or near the surface, but the Pickford soils are free of lime to a depth of 10 or more inches.

Minor areas are occupied by the somewhat poorly drained Selkirk and Rudyard soils and the poorly drained Hettinger, Bergland, and Sims soils. The Selkirk, Rudyard, and Bergland soils formed in clay or silty clay, but the Hettinger and Sims formed in clay loam. Hettinger soils contain thin layers of silt, fine sand, and clay.

Soils of this association are productive, and many crops grow well if the areas are artificially drained. Also, because of the fine texture of the soils, proper tillage is needed and other farming operations must be done at the proper time. Sugarbeets, small grain, corn, and field beans are the principal crops grown. Use of the areas for trees or for residential or recreational development is severely limited.

5. Iosco-Kawkawlin-Sims Association

Mainly nearly level to undulating, somewhat poorly drained and poorly drained soils formed in clay loam or in sand underlain by clay loam

This soil association is on nearly level to undulating plains that include some broad, gently sloping, low ridges. The ridges range from a few feet to a quarter of a mile in width and from 1 to 4 feet in height. Some of the soils formed in sand overlying clay loam, but others formed entirely in clay loam. Some of the soils formed under a fluctuating water table, but others formed under a high water table.

The Iosco soils formed under influence of a fluctuating water table in 18 to 42 inches of sand or loamy sand over clay loam. The Kawkawlin and Sims soils formed in clay loam—the Kawkawlin under influence of a fluctuating water table, and the Sims under influence of a high water table. In some areas the Kawkawlin soils have a thin upper layer of sand, loamy sand, or sandy loam.

Minor soils in this association are the well-drained Nester soils; the somewhat poorly drained Allendale, Ingalls, and Twining soils; and the poorly drained Brevort soils. Nester soils formed in clay loam, and the Twining soils in sandy clay loam. In some areas these soils have a thin upper layer of sand, loamy sand, or sandy loam. The Allendale, Ingalls, and Brevort soils formed in sand or loamy sand 18 to 42 inches thick. Allendale soils formed over clay or silty clay, the Ingalls over silt and fine sand, and the Brevort over clay loam.

Crops and yields on soils in this association vary, depending on the kind of soil that is dominant on a particular farm. If sandy soils are dominant, the crops commonly grown are less well suited and yields are less than on farms where the dominant soil is clay loam. Also, before crops can be grown successfully on any of the soils, artificial drainage is needed. Sandy soils also require frequent additions of organic material.

Most farms in this association are dairy farms. Use of the soils for trees or for residential or recreational development is severely limited.

6. Allendale-Pinconning-Pickford Association

Nearly level to undulating, somewhat poorly drained and poorly drained soils formed in sandy material over clay or silty clay or in clay or silty clay

This association is on a gently undulating plain that includes some small nearly level areas in stream valleys. It is dominated by soils that formed in clay or that are underlain by clay. The Allendale and Pinconning soils formed in 18 to 42 inches of sand or loamy sand underlain by clay or silty clay. Pickford soils formed in clay or silty clay, but some areas have a thin upper layer of sand, loamy sand, or sandy loam. The Allendale soils formed under influence of a fluctuating water table, and the Pinconning and Pickford under influence of a high water table.

Minor soils are the somewhat poorly drained, clayey Selkirk and Rudyard and the well-drained, sandy Manistee. Manistee soils formed in 18 to 42 inches of sand or loamy sand over clay loam.

The success of agriculture in this association is variable and depends on the proportion of Allendale soils on a particular farm. It is difficult to drain the soils because of the underlying clay or silty clay. The kinds of crops that can be grown are therefore limited, and in places yields are below average.

Dairy farming is the main enterprise, but some cash crops are grown. The areas are somewhat limited for woodland, residential, and recreational uses.

7. Grayling Association

Nearly level to undulating, well drained to moderately well drained sands

This soil association occupies high outwash plains that are level to undulating. In the undulating areas slopes are short and range from about 4 to 8 percent. Some level areas are fairly large and are steeply sloping where they adjoin stream valleys.

The Grayling soils, which make up this association, formed in medium and coarse sand and are droughty. They are poorly suited to crops or pasture. Most areas are in public ownership and have stands of red oak and aspen on them that are of poor quality. Limitations to use of the areas as woodland are severe, and those for residential or recreational use are slight.

The composition of this association is necessarily more variable than that of the unit having the same name on the detailed soil map.

8. Rubicon Association

Level to rolling, well drained to moderately well drained sands

This soil association is on level to rolling plains that have short slopes and include a few prominent ridges which have steep slopes. There are generally deep valleys nearby.

Rubicon soils are well drained, are droughty, and are low in fertility. Minor soils in the association are the well-drained Menominee and Grayling and the somewhat poorly drained Au Gres. The Menominee soils formed in sand or loamy sand 18 to 42 inches thick over loam or clay loam. The Grayling and Au Gres soils formed in sand. These minor soils, like the Rubicon, are droughty and low in fertility.

Soils of this association are not used for crops or pasture. They are mainly in trees, and yields are low. Limitations to use of the soils as residential and recreational areas are slight.

9. Roscommon-Au Gres Association

Mainly level to gently undulating, somewhat poorly drained to very poorly drained, deep sands

This soil association is on low-lying, level to gently undulating outwash plains that include some depressional areas and a few low ridges. The slope of the ridges is generally less than 6 percent.

The Roscommon and Au Gres soils formed in sand—the Roscommon under influence of a high water table, and the Au Gres under influence of a fluctuating water table. The Au Gres soils are very strongly acid to slightly acid, and the Roscommon are medium acid to neutral.

Minor areas in the association are occupied by the well-drained, sandy Rubicon soils and by the somewhat poorly drained, sandy Saugatuck soils, which have a hardpan. Also inextensive are areas of Tawas soils, which consist of 12 to 42 inches of muck over sand.

Soils of this association are not used for farming and are poorly suited to trees. They are wet, acid, and low in fertility. Most areas are also poorly suited to residential or recreational use, though in places the Rubicon soils have value for residential use.

10. Epoufette-Lacota Association

Nearly level, poorly drained, sandy or loamy soils underlain by limy sand and gravel

This soil association is on nearly level plains that have a few low ridges and old stream channels. The soils of this association formed under influence of a high water table and are underlain by limy sand and gravel. Epoufette soils formed in sand and loamy sand, and Lacota soils formed in loam, clay loam, or silty clay 18 to 42 inches thick.

Minor soils are the somewhat poorly drained Gladwin and the poorly drained Roscommon and Saganing. Gladwin soils have a layer of sandy loam at a depth of 20 to 35 inches that is 4 to 10 inches thick. Saganing soils consist of 18 to 42 inches of sandy loam, and Roscommon soils are deep and sandy.

On the farms in this association, dairying and growing of cash crops are combined. Productivity of the Epoufette soils is moderate to moderately low, and that of the Lacota is high. Both need drainage. Limitations to use of the soils for woodland and for residential and recreational development are severe.

11. Rubicon-Gladwin-Nester Association

Level to steep, well-drained to somewhat poorly drained soils from varied materials

This soil association is in a long, narrow area along the valley of the Rifle River. The soils are on a series of terraces and upland areas. Slopes range from level to steep and are more than 25 percent in many places.

Soils in this association are the well-drained Rubicon and Nester and the somewhat poorly drained Gladwin. The Rubicon soils in this association are the moderately fine substratum phases of the series. These soils formed in sand or loamy sand 42 to 66 inches thick over clay loam. Nester soils formed in clay loam, and the Gladwin in sand or sandy loam over limy sand and gravel.

Minor soils are the well-drained, sandy Menominee and Manistee; the somewhat poorly drained, sandy Allendale; and the shallow, mucky Tawas. Menominee soils are underlain by clay loam at a depth of 18 to 42 inches,

and the Manistee and Allendale soils are underlain by clay at the same depth. Tawas muck is underlain by sand at a depth of 12 to 42 inches.

Characteristics of soils in this association vary, and productivity therefore varies. Use of the steep soils for farming is limited. The wet soils need drainage, and even then the yields are low. The well-drained soils are well suited to trees and to use as residential and recreational areas.

12. Tawas-Carbondale Association

Shallow to deep, very poorly drained, organic soils in level to depressional areas

This soil association is on low, level to nearly level plains that include some depressions. It consists of organic soils of varying depth. Tawas soils are underlain by sand at a depth of 12 to 42 inches, but the Carbondale soils are more than 42 inches deep. Minor soils in this association are the shallow Willette, Linwood, Edwards, and Adrian. In all of these soils, mineral material is within 12 to 42 inches of the surface. The Willette soils are underlain by clay, the Linwood by loam, the Edwards by marl, and the Adrian by sand. The Adrian soils contain less woody material than the Tawas soils.

If these soils are drained, they are moderately productive. In addition to drainage they need controls for maintaining the water level. They also need protection from wind erosion. The soils are well suited to frost-resistant crops if properly drained and fertilized. Use of the soils as woodland or as residential and recreational areas is severely limited.

13. Eastport Association

Well-drained to poorly drained, sandy soils on low beach ridges and in swales

This soil association is on a series of low beach ridges and swales along the shore of Lake Huron. The ridges are 3 to 8 feet high and have slopes of 2 to 10 percent.

The dominant Eastport soils are on the ridges. These soils are well drained to moderately well drained, slightly acid sands that are droughty and infertile. Minor soils include the well-drained, acid, sandy Rubicon; the somewhat poorly drained, acid, sandy Au Gres; the poorly drained, sandy Roscommon; and the shallow, mucky Tawas. The Au Gres, Roscommon, and Tawas soils are in the depressions between areas of Eastport soils.

Because of wetness, droughtiness, and low fertility, soils of this association are not used for farming. Some areas are used as residential and recreational developments.

Descriptions of the Soils

This section is provided for those who want detailed information about the soils in the county. It describes each soil series, a typical profile for the series, and then each mapping unit; that is, the areas on the detailed soil map that are bounded by lines and identified by a symbol. The soils are described approximately in alphabetic order. The descriptions of the soils generally tell how their profile differs from that of the series, or the differences are indicated in the soil name.

A mapping unit generally contains more than one kind of soil but is named for the soil that makes up 85 percent or more of the area. As much as 15 percent of other kinds of soils are included in most mapping units. The significant included soils are indicated and a brief description of each is given in the description of the particular mapping unit. If the mapping unit contains two or more kinds of soil, each of which occupies more than 15 percent of the area, the mapping unit is named for the two or three most extensive soils in the mapping unit and is described under the first soil series in the name of the unit.

Also indicated in the name of most mapping units are the percentage of slope and the degree of erosion. If erosion is not indicated, the particular soil is not eroded or is slightly eroded. Many of the soils have names made up only of the series and type names, since they have no variations in slope, erosion, or other properties normally designated for the soil phase. Bowers silty clay loam is an example. Listed at the end of the description of each mapping unit are the soil management unit and woodland suitability group in which this unit has been placed. The page on which the groups are described is listed in the "Guide to Mapping Units" at the back of this survey.

For more general information about the soils, the reader can refer to the section "General Soil Map," in which the broad patterns of soils are described. The approximate acreage and proportionate extent of each mapping unit are given in table 1, and their location is shown on the soil map at the back of this survey. Terms used to describe the soils are given in the Glossary. Technical descriptions of each series are provided in the section "Detailed Descriptions of Soil Series."

Adrian Series

In the Adrian series are dark-colored, very poorly drained soils. These soils consist of layers of peat and muck underlain by sandy deposits at a depth of 12 to 42 inches. The original vegetation was sedges, reeds, willow, and tag alder.

Representative profile of Adrian muck:

0 to 12 inches, black, friable muck; in places contains pieces of woody material.
12 to 20 inches, dark yellowish-brown, fibrous peat; contains partly rotted sedges, reeds, and pieces of woody material.
20 to 26 inches, very dark grayish-brown, fibrous peat.
26 to 42 inches +, light brownish-gray, loose sand.

The upper three layers consist of peat, muck, or a combination of the two. These layers consist mainly of the remains of sedges and reeds but contain bits of woody material. Their combined thickness ranges from 12 to 42 inches. In places thin layers of sand separate the organic layers. Underlying the organic layers is a layer of sand or loamy sand that in a few places contains very thin silty or mucky layers. The soils are strongly acid to neutral throughout.

Permeability of these soils is moderately rapid. Runoff is slow or is ponded.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Adrian muck	342	0.1
Adrian association	464	.2
Adrian-Eastport-Rubicon association, undulating	288	.1
Allendale loamy sand, 0 to 2 percent slopes	4,455	1.9
Allendale loamy sand, 2 to 6 percent slopes	284	.1
Alluvial land, coarse	517	.2
Alluvial land, medium	6,867	2.9
Alluvial land, moderately fine	578	.2
Arenac (See Au Gres, loamy substratum).		
Au Gres sand, 0 to 2 percent slopes	9,034	3.8
Au Gres sand, 2 to 6 percent slopes	514	.2
Au Gres sand, loamy substratum, 0 to 2 percent slopes	4,385	1.8
Au Gres sand, loamy substratum, 2 to 6 percent slopes	679	.3
Au Gres association	6,705	2.8
Au Gres-Roscommon association	2,173	.9
Au Gres-Rubicon association	2,636	1.1
Bergland mucky loam	348	.1
Bohemian loamy fine sand, 0 to 2 percent slopes	55	(1)
Bohemian loamy fine sand, 2 to 6 percent slopes	66	(1)
Bohemian loamy fine sand, 6 to 12 percent slopes	40	(1)
Bohemian very fine sandy loam, 0 to 2 percent slopes	86	(1)
Bohemian very fine sandy loam, 2 to 6 percent slopes	105	(1)
Bowers loam	114	(1)
Bowers silty clay loam	296	.1
Brevort fine sandy loam	812	.3
Brevort loamy sand	6,613	2.8
Brevort sand	244	.1
Brevort-Kawkawlin association	144	.1
Brevort-Roscommon association	381	.2
Brimley fine sandy loam, 0 to 2 percent slopes	521	.2
Brimley fine sandy loam, 2 to 6 percent slopes	221	.1
Brimley loam, 0 to 2 percent slopes	195	.1
Brimley loam, 2 to 6 percent slopes	105	(1)
Brimley loamy fine sand, 0 to 2 percent slopes	121	.1
Brimley loamy fine sand, 2 to 6 percent slopes	48	(1)
Bruce fine sandy loam	758	.3
Bruce loamy fine sand	71	(1)
Bruce silt loam	479	.2
Burleigh loamy sand	1,021	.4
Carbondale muck and peat	3,280	1.4
Charity silty clay loam	3,316	1.4
Dawson-Greenwood peats	215	.1
Deford loam	196	.1
Deford loamy fine sand	3,362	1.4
Duel loamy sand, 0 to 2 percent slopes	157	.1
Duel loamy sand, 2 to 6 percent slopes	161	.1
Duel loamy sand, 6 to 12 percent slopes	44	(1)
Eastport-Rubicon sands, 0 to 6 percent slopes	3,029	1.3
Eastport-Rubicon sands, 6 to 12 percent slopes	1,298	.6
Eastport-Rubicon sands, 6 to 12 percent slopes, moderately eroded	144	.1
Eastport-Rubicon sands, 12 to 18 percent slopes	148	.1
Eastport-Rubicon sands, 12 to 18 percent slopes, moderately eroded	58	(1)
Eastport-Rubicon sands, 18 to 25 percent slopes, moderately eroded	36	(1)
Eastport-Rubicon sands, 25 to 45 percent slopes	31	(1)
Eastport-Rubicon association, rolling	1,546	.7
Eastport-Rubicon-Roscommon association, undulating	1,756	.7
Edwards muck	449	.2
Epoufette sandy loam	700	.3
Essexville loamy fine sand	310	.1
Fresh water marsh	2,302	1.0
Gladwin loamy sand	466	.2
Gladwin-Allendale association, undulating	1,932	0.8
Gravel and sand pits	58	(1)
Grayling association	11,033	4.7
Gullied land	27	(1)
Hettinger clay loam	850	.4
Hettinger loam	619	.3
Hettinger silty clay loam	1,097	.5
Ingalls loamy sand, 0 to 2 percent slopes	1,265	.5
Ingalls loamy sand, 2 to 6 percent slopes	217	.1
Iosco loamy sand, 0 to 2 percent slopes	10,765	4.5
Iosco loamy sand, 2 to 6 percent slopes	2,631	1.1
Iosco sand, 0 to 2 percent slopes	633	.3
Iosco sand, 2 to 6 percent slopes	119	.1
Iosco-Rubicon association, undulating	1,846	.8
Isabella-Ubly loamy sands, 0 to 2 percent slopes	522	.2
Isabella-Ubly loamy sands, 2 to 6 percent slopes	1,123	.5
Isabella-Ubly loamy sands, 6 to 12 percent slopes	487	.2
Isabella-Ubly loamy sands, 12 to 18 percent slopes	129	.1
Isabella-Ubly loamy sands, 25 to 55 percent slopes	69	(1)
Isabella-Ubly sandy loams, 0 to 2 percent slopes	324	.1
Isabella-Ubly sandy loams, 2 to 6 percent slopes	1,460	.6
Isabella-Ubly sandy loams, 2 to 6 percent slopes, moderately eroded	83	(1)
Isabella-Ubly sandy loams, 6 to 12 percent slopes	104	(1)
Isabella-Ubly sandy loams, 6 to 12 percent slopes, moderately eroded	338	.1
Kawkawlin loam, 0 to 2 percent slopes	2,656	1.1
Kawkawlin loam, 2 to 6 percent slopes	298	.1
Kent loam, 0 to 2 percent slopes	70	(1)
Kent loam, 2 to 6 percent slopes	173	.1
Kent loam, 6 to 12 percent slopes	102	(1)
Lacota loam	82	(1)
Lacota sandy clay loam	772	.3
Lacota silty clay loam	193	.1
Lake beach	430	.2
Linwood peat and muck	2,234	.9
Mancelona loamy sand, 0 to 2 percent slopes	445	.2
Mancelona loamy sand, 2 to 6 percent slopes	57	(1)
Manistee loamy sand, 0 to 2 percent slopes	74	(1)
Manistee loamy sand, 2 to 6 percent slopes	46	(1)
Markey muck	68	(1)
Maumee mucky loamy sand	220	.1
Maumee mucky sandy loam	196	.1
Maumee association	1,152	.5
Melita (See Rubicon, moderately fine substratum).		
Menominee loamy sand, 0 to 2 percent slopes	734	.3
Menominee loamy sand, 2 to 6 percent slopes	1,700	.7
Menominee loamy sand, 6 to 12 percent slopes	467	.2
Menominee loamy sand, 12 to 18 percent slopes	110	(1)
Menominee loamy sand, 18 to 25 percent slopes	31	(1)
Menominee loamy sand, 25 to 45 percent slopes, moderately eroded	21	(1)
Menominee sand, 0 to 2 percent slopes	331	.1
Menominee sand, 2 to 6 percent slopes	793	.3
Menominee sand, 6 to 12 percent slopes	194	.1
Nester clay loam, 6 to 12 percent slopes, severely eroded	105	(1)
Nester clay loam, 12 to 18 percent slopes, severely eroded	162	.1
Nester clay loam, 18 to 25 percent slopes, severely eroded	117	(1)
Nester clay loam, 25 to 55 percent slopes, severely eroded	31	(1)
Nester fine sandy loam, 0 to 2 percent slopes	1,230	.5
Nester fine sandy loam, 2 to 6 percent slopes	5,642	2.4
Nester fine sandy loam, 2 to 6 percent slopes, moderately eroded	306	.1
Nester fine sandy loam, 6 to 12 percent slopes	632	.3

See footnote at end of table.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil	Acres	Percent
Nester fine sandy loam, 6 to 12 percent slopes, moderately eroded	840	0.4
Nester fine sandy loam, 12 to 18 percent slopes	54	(1)
Nester fine sandy loam, 12 to 18 percent slopes, moderately eroded	198	.1
Nester fine sandy loam, 18 to 25 percent slopes	135	.1
Nester fine sandy loam, 18 to 25 percent slopes, moderately eroded	109	(1)
Nester fine sandy loam, 25 to 55 percent slopes	536	.2
Nester fine sandy loam, 25 to 55 percent slopes, moderately eroded	88	(1)
Nester loam, 2 to 6 percent slopes	182	.1
Nester silty clay loam, 2 to 6 percent slopes	340	.1
Nester-Iosco-Rubicon association, steep	545	.2
Pickford fine sandy loam	885	.4
Pickford loamy sand	67	(1)
Pickford silty clay	1,245	.5
Pickford silty clay loam	2,402	1.0
Pinconning loamy sand	3,105	1.3
Richter loam, 0 to 2 percent slopes	70	(1)
Richter loamy sand, 0 to 2 percent slopes	274	.1
Richter sandy loam, 0 to 2 percent slopes	526	.2
Richter sandy loam, 2 to 6 percent slopes	101	(1)
Richter association	144	.1
Rifle peat	220	.1
Roscommon loamy sand	2,543	1.1
Roscommon sand	10,415	4.4
Roscommon association	8,670	3.6
Roscommon-Au Gres-Rubicon association, undulating	924	.4
Rousseau loamy fine sand, 0 to 2 percent slopes	120	.1
Rousseau loamy fine sand, 2 to 6 percent slopes	169	.1
Rousseau loamy fine sand, 12 to 18 percent slopes	44	(1)
Rubicon loamy sand, moderately fine substratum, 0 to 6 percent slopes	223	.1
Rubicon loamy sand, moderately fine substratum, 6 to 12 percent slopes	40	(1)
Rubicon sand, 0 to 6 percent slopes	4,683	2.0
Rubicon sand, 6 to 12 percent slopes	572	.2
Rubicon sand, 12 to 18 percent slopes	207	.1
Rubicon sand, 18 to 25 percent slopes	91	(1)
Rubicon sand, 25 to 45 percent slopes	230	.1
Rubicon sand, moderately fine substratum, 0 to 6 percent slopes	1,868	.8
Rubicon sand, moderately fine substratum, 6 to 12 percent slopes	386	.2
Rubicon sand, moderately fine substratum, 12 to 18 percent slopes	63	(1)
Rubicon association, undulating	3,839	1.6
Rubicon association, rolling	657	.3
Rubicon-Iosco association, undulating	558	.2
Rudyard silty clay loam, 0 to 2 percent slopes	157	.1
Saganing sandy loam	687	.3
Saugatuck loamy sand	152	.1
Saugatuck sand	237	.1
Selkirk fine sandy loam, 0 to 2 percent slopes	669	.3
Selkirk loam, 0 to 2 percent slopes	1,914	.8
Selkirk loam, 2 to 6 percent slopes	141	.1
Selkirk loamy sand, 0 to 2 percent slopes	423	.2
Selkirk silt loam, 0 to 2 percent slopes	142	.1
Selkirk silty clay loam, 0 to 2 percent slopes	169	.1
Sims clay loam	6,087	2.6
Sims loam	2,609	1.1
Sims loamy sand	304	.1
Sims sandy loam	2,954	1.3
Stone quarries	31	(1)
Summerville sandy loam, 0 to 2 percent slopes	109	(1)
Summerville sandy loam, 2 to 6 percent slopes	60	(1)
Tawas peat, burned	274	.1
Tawas peat and muck	3,923	1.6
Tawas association	1,672	.7
Tawas-Carbondale association	1,118	.5
Tawas-Roscommon association	756	.3
Tobico loamy fine sand	194	.1
Tobico sandy loam	101	(1)
Tonkey loam	915	.4
Tonkey loamy sand	128	.1
Tonkey sandy loam	1,540	.7
Twining loam, 0 to 2 percent slopes	504	.2
Twining-Belding loamy sands, 0 to 2 percent slopes	2,254	1.0
Twining-Belding loamy sands, 2 to 6 percent slopes	200	.1
Twining-Belding sandy loams, 0 to 2 percent slopes	9,668	4.1
Twining-Belding sandy loams, 2 to 6 percent slopes	1,660	.7
Wainola loamy fine sand, 0 to 2 percent slopes	681	.3
Wainola loamy fine sand, 2 to 6 percent slopes	184	.1
Warners muck and marl	135	.1
Willette muck	863	.4
Wisner clay loam	4,253	1.8
Wisner loam	2,150	.9
Wisner sandy loam	1,760	.7
Total	235,520	100.0

[1] Less than 0.05 percent.

Adrian muck (Aa).—The surface layer of this nearly level soil is generally black muck, but in places it is yellowish-brown peat. In a few areas the underlying sandy layer is underlain by loamy to clayey material at a depth of less than 42 inches.

Included with this soil in mapping are areas of Rifle soils in which the thickness of the organic layers is more than 42 inches. Also included are other areas where the organic layers are less than 12 inches thick.

This Adrian soil is severely limited for crops because it is shallow, has a high water table, and is subject to wind erosion. If it is used for crops, artificial drainage must be supplied, fertilizer applied, and practices that control wind and water erosion used. Yields of corn, sugarbeets, and vegetable crops are moderately high to high if the soil is well managed.

Adrian muck is poorly suited to trees. Yields are low, the timber is of poor quality, and damage from windthrow is high. Because of the high water table, use of this soil for building sites is severely limited.

Soil management unit M/4c (IVw); woodland suitability group J.

Adrian association (Ad).—This mapping unit is in depressions that have a flat bottom or is in level areas where a thin layer of muck or peat covers sandy material. It consists of Adrian soils formed in 12 to 42 inches of muck or peat over sand or loamy sand. In the center of some of the larger areas, the layers of muck and peat are more than 42 inches thick. Toward the edges of these areas, the organic material is less than 12 inches thick.

The organic layers that make up the upper part of these soils range from black, granular muck to brown, fibrous peat, but they generally are a mixture of both. These

layers contain chunks of wood throughout, and they range from strongly acid to neutral. The lower, or mineral, part of the soils is light brownish-gray sand that is mottled with olive brown in places. Drainage is very poor, and in many places the water table is only a few inches below the surface.

This mapping unit has little value for crops or trees. Drainage is needed if the areas are cultivated, but the water level must be properly maintained to prevent overdraining. Wind erosion is also a hazard. The high water table severely limits use of this unit for building sites.

Soil management unit M/4c (IVw); woodland suitability group J.

Adrian-Eastport-Rubicon association, undulating (AeB).—This mapping unit is along the shore of Lake Huron. The areas are a series of low sandy beach ridges separated by strips of shallow muck or peat over sand. Both the ridges and the strips of muck are too narrow to be mapped separately.

The ridges that make up this unit are 3 to 8 feet high and 30 to 60 feet across. On the tops of the ridges are the Eastport and Rubicon soils, which are sandy and are well drained or moderately well drained. Thin layers of fine sand and coarse sand and gravel are in the lower part of these soils. On the lower slopes of the ridges are the somewhat poorly drained Au Gres soils. These soils are darker colored than the Eastport or Rubicon soils and are mottled at a depth of 18 inches or less. In the low flat areas between the ridges are the Adrian soils. These soils formed in muck or peat and are underlain by sand at a depth between 12 and 42 inches. The deposit of muck or peat is thickest in the center of the areas of the Adrian soils and thinnest near the ridges.

Areas of this mapping unit are in second-growth trees or are in brush. Drainage problems in the Adrian and Au Gres soils and the low fertility and hazard of erosion in the Eastport and Rubicon soils make these soils poorly suited to crops or trees. These soils are also severely limited for use as building sites.

Soil management unit 5c (IVw); woodland suitability group J.

Allendale Series

In the Allendale series are light-colored, somewhat poorly drained, sandy soils. These soils are underlain by silty clay or clay at a depth of 18 to 42 inches. The original vegetation was mainly a mixture of upland and lowland hardwoods but included a few white pines.

Representative profile of an Allendale loamy sand in an uncultivated area:

0 to 3 inches, black, very friable loamy sand.
3 to 10 inches, light brownish-gray, loose sand.
10 to 23 inches, yellowish-brown, loose sand mottled with brown.
23 to 25 inches, reddish-brown, friable sandy loam.
25 to 42 inches +, reddish-brown, firm clay.

The upper four layers, the sandy part of the profile, range from 18 to 42 inches in thickness. The material in the upper three layers is generally loose, but in a few places the third layer contains chunks of firmly cemented sand. In many places the fourth layer is lacking and the upper three layers rest directly on clay. The upper part of the profile is slightly acid to mildly alkaline; the material just above the clay is limy in places. The underlying clay is generally limy, but the upper few inches is usually free of lime. During wet periods the water table rises above the underlying clay.

In cultivated areas plowing has mixed material from the upper part of the second layer with the first layer to form a grayish-brown plow layer. The second layer in these areas is thinner than described, or where depth of plowing exceeds 10 inches, it is lacking.

Permeability of these soils is very rapid in the upper three layers, moderately rapid in the fourth layer, and very slow below. Runoff is slow.

Allendale loamy sand, 0 to 2 percent slopes (AmA).—This nearly level soil is generally in low areas. The texture of the surface soil is dominantly loamy sand, but it is sand or fine sand in small areas. Below the surface soil the texture ranges from sand to loamy sand. The soil is grayer in the low, poorly drained areas than in higher lying, better drained areas, where it is more brown. Some areas are slightly eroded, and here the yellowish-brown subsoil is exposed by plowing.

Included with this soil in mapping are poorly drained Pinconning and Pickford soils in small depressions and shallow waterways. Also included are the well drained or moderately well drained, sandy Manistee and Rubicon soils on high areas where slopes are short. Other included soils are the Selkirk and Rudyard, in areas where sandy material is less than 18 inches thick, and Au Gres soils, in areas where sandy material is more than 42 inches thick.

This Allendale soil is moderately well suited to row crops and to trees. Except for sugarbeets, all crops common to the county are grown. Yields are moderately high under good management. In places artificial drainage is needed. Control of wind erosion is also needed in places. A seasonal high water table makes this soil somewhat limited for use as building sites.

Soil management unit 4/lb (IIIw); woodland suitability group G.

Allendale loamy sand, 2 to 6 percent slopes (AmB).—This gently sloping soil is on the lower slopes of hills and ridges and is therefore somewhat better drained than Allendale loamy sand, 0 to 2 percent slopes. A few small areas are eroded, and here plowing has exposed yellowish-brown material from the subsoil. Slopes are dominantly 2 to 6 percent but range outside these limits in small areas.

Included with this soil in mapping are small areas of the well-drained, sandy Manistee and Rubicon soils on higher areas within this soil. Also included are poorly drained Pinconning soils in small depressions and drainageways, especially where slopes are short. Other included soils are the Selkirk and Rudyard, in small areas where the sandy material is less than 18 inches thick, and Au Gres soils, in areas where the sandy material is more than 42 inches thick.

This Allendale soil is moderately well suited to row crops and to trees. Except for sugarbeets, all crops common to the county are grown. Yields are moderately high under good management. Artificial drainage is needed in places, but the slope is likely to make it difficult to install and maintain a drainage system in places. A seasonal high water table somewhat limits the soil for use as building sites.

Soil management unit 4/lb (IIIw); woodland suitability group G.

Alluvial Land

Alluvial land consists of land types made up of coarse, medium, or moderately fine textured soil material. The areas are along streams and are subject to flooding.

Alluvial land, coarse (An), is along fairly large streams in nearly level areas that are subject to periodic flooding. It consists of thin layers of very poorly drained to somewhat poorly drained soil material laid down by stream overflow. The number, texture, and sequence of the layers vary widely within a short distance. In places the texture is that of loamy sand, sand, gravel, or other coarse-textured material, but in a few places the layers are finer textured. The material is dominantly gray, but in some places it is mottled with brown. Layers of old, buried soils made up of black organic material from decayed grasses and weeds also occur in places.

If this soil is protected from floods and the water table is lowered, Alluvial land, coarse, is well suited to all crops commonly grown in the county except sugarbeets. Yields range from moderate to poor. This soil is poorly suited to trees. The high water table and the hazard of flooding severely limit use of the areas for building sites or recreational areas.

Soil management unit Lc (Vw); woodland suitability group O.

Alluvial land, medium (Ao), is on nearly level flood plains of major streams in the county and is subject to periodic flooding. It consists of very poorly drained to somewhat poorly drained soil material laid down by floods. The floods last for a short time and are separated by long intervals, and the layers vary in thickness, texture, and sequence. In most places the texture is sandy loam, loam, or silt loam, but in many places the layers are coarser textured or finer textured. The material is dominantly gray but in places is mottled. Layers that are very dark are old, buried soils made up of organic material from decayed grasses.

If this soil is protected from floods and the water table is lowered, it is well suited to the crops commonly grown in the county. Yields are high. The soil is poorly suited to trees. The high water table and hazard of flooding severely limit use of the areas for building sites or recreational areas.

Soil management unit Lc (Vw); woodland suitability group O.

Alluvial land, moderately fine (Ap), is on nearly level flood plains of slowly flowing, permanent streams in the county and is subject to periodic flooding. It consists of thin layers of very poorly drained to somewhat poorly drained soil material deposited by stream overflow. The floods are short and occur at long intervals. The layers therefore vary in thickness, texture, and sequence within a short distance. In most places the texture is clay loam or silty clay loam, but in some places layers of sand, gravel, loam, and silt loam are common. The material is dominantly gray but in places is mottled with brown. Layers of old, buried soils made up of very dark material from decayed grasses also occur in places.

If this land type is protected from flooding and the water table is lowered, it is well suited to the crops grown in the county. Yields are high. This land type is poorly suited to trees. The high water table and hazard of flooding severely limit its suitability for building sites or recreational sites.

Soil management unit Lc (Vw); woodland suitability group O.

Au Gres Series

Soils of the Au Gres series are deep, moderately dark colored, somewhat poorly drained, and sandy. These soils are on level to gently sloping plains. The original vegetation was mostly cedar, hemlock, fir, and aspen but included a few hardwoods.

Representative profile of an Au Gres sand in a wooded area:

0 to 4 inches, dark-gray, very friable sand.
4 to 9 inches, light brownish-gray, loose sand.
9 to 17 inches, dark reddish-brown to dark yellowish-brown, very friable sand.
17 to 30 inches, light yellowish-brown, loose sand mottled with brown.
30 to 60 inches +, light-gray, loose sand mottled with yellowish brown.

In cultivated areas plowing has mixed material from the upper part of the second layer with the first layer to form a gray plow layer. The third layer is darkest at the top and is lighter with increasing depth. It contains chunks of firmly cemented material in places. The two layers below are mainly loose sand that in places contains small amounts of gravel. These layers grade into each other and are difficult to distinguish in the field. In places the lower part of the fourth layer is limy. In some places the texture at a depth below 42 inches is loam to clay loam. Mottling is common at a depth below 12 to 24 inches but in places occurs at a depth of 6 inches. The upper part of the profile is very strongly acid to slightly acid.

Permeability of these soils is moderately rapid. Runoff is very slow to ponded.

Au Gres sand, 0 to 2 percent slopes (ArA).—This soil is on outwash plains, where slopes are mostly less than 2 percent. Many wooded areas are hummocky because of tree throw. The hummocks are 2 to 4 feet high and 10 to 20 feet across, and pockets between them hold water for extended periods.

Included with this soil in mapping are a few soils on low ridges where slopes are more than 2 percent. The well-drained Rubicon soils, which are mottled at a depth below 24 inches, are on the tops and sides of some of the ridges, and the poorly drained or very poorly drained Roscommon soils are in shallow depressions and along minor natural drainageways. Also included are areas of soils that are underlain by loamy or clayey material at a depth of 42 to 66 inches.

Most areas of this Au Gres soil have a cover of second-growth trees in which aspen is dominant. Only a small acreage is farmed, and on this drainage and wind erosion are problems.

Low fertility, droughtiness, and a high water table during part of the year make this soil poorly suited to crops. Yields of crops are moderate to low. This soil is moderately well suited to trees. Because of the fluctuating water table, use of this soil for building sites or recreational areas is somewhat limited. Maintaining a cover of grass on the areas is moderately difficult.

Soil management unit 5b (IVw); woodland suitability group F.

Au Gres sand, 2 to 6 percent slopes (ArB).—This soil is on gently sloping low ridges, and it therefore has slightly better natural drainage than Au Gres soils in level areas. A few areas are hummocky because of tree throw. In many small areas slopes are less than 2 percent, and in a few areas they are more than 6 percent.

Included with this soil in mapping are small areas of moderately well drained soils on knolls and ridges. Also included are areas of the poorly drained and very poorly drained Roscommon soils, in depressions, and a few small areas that are underlain by loamy or clayey material at a depth of 42 to 66 inches.

Low fertility, droughtiness, and a moderately high water table during part of the year make this Au Gres soil poorly suited to crops. Yields of crops on the soil are low. This soil is moderately well suited to trees. Because of the fluctuating water table, use for building sites, recreational areas, and similar purposes is somewhat limited. Maintaining a cover of grass is difficult.

Soil management unit 5b (IVw); woodland suitability group F.

Au Gres sand, loamy substratum, 0 to 2 percent slopes (AsA).[1]—This soil is in nearly level areas where drainage is somewhat restricted. The texture of the surface soil varies. It is sand in about 80 percent of the area, fine sand in 15 percent, and loamy sand in about 5 percent. In a few small areas, much of the original surface soil has been removed through erosion, and plowing has mixed material from the third layer with the remaining surface soil. Grayish-brown material from this layer can be seen in places on the surface of plowed fields. Slopes are greater than 2 percent in a few small areas.

Included with this soil in mapping are small areas of the poorly drained and very poorly drained Roscommon, Pinconning, and Brevort soils in small depressions and along minor natural drainageways. On small and somewhat higher knolls and ridges are the well-drained Rubicon soils. Also included are areas of sandy Iosco and Allendale soils that are generally less than 42 inches thick but in places are more than 66 inches thick.

This Au Gres soil is only moderately well suited to crops, because of its high water table, low fertility, and droughtiness. The high water table also makes use of the soil for building sites somewhat limited.

Soil management unit 5/2b (IIIw); woodland suitability group F.

Au Gres sand, loamy substratum, 2 to 6 percent slopes (AsB)[2].—This gently sloping soil has slightly better natural drainage than similar soils in nearly level areas. The texture of the surface soil is dominantly sand, but it is fine sand in a few areas. In a few cultivated areas, plowing has mixed material from the original third layer with the surface soil. This soil is subject to wind erosion if cultivated.

Included with this soil in mapping are small areas of poorly drained and very poorly drained Roscommon, Pinconning, and Brevort soils in depressions and along drainageways. Well-drained Rubicon soils are on the tops and upper slopes of some of the ridges. Also included are areas of the Iosco and Allendale soils, which are generally less than 42 inches thick but in places are more than 66 inches thick.

This Au Gres soil is only moderately well suited to crops, because of the periodical high water table, low fertility, and droughtiness. It is also moderately well suited to trees. The water table somewhat limits the use of this soil for building sites.

Soil management unit 5/2b (IIIw); woodland suitability group F.

Au Gres association (Au).—The soils in this mapping unit are sandy and nearly level to gently sloping. They are on outwash plains where the water table is high during part of the year. Slopes are mostly less than 6 percent and in large areas do not exceed 2 percent.

Dominant in this mapping unit are the Au Gres soils. These soils are sandy throughout, have somewhat poor natural drainage, and are mottled at a depth of 12 to 24 inches. Next most extensive are the Saugatuck soils. These soils are similar to the Au Gres but have a firmly cemented hardpan at a depth of 10 to 24 inches. Other soils are the Roscommon, in low, level areas, and the Rubicon, on a few higher and steeper ridges. Roscommon soils are poorly drained to very poorly drained and have a dark-colored, mucky surface layer. Rubicon soils are well drained, are brighter colored than the Au Gres soils, and are free of mottling to a depth of 3 feet or more. Included are a few areas of muck or peat and some small leatherleaf bogs. The muck or peat is mostly less than 42 inches thick.

Because of drainage and fertility problems, this mapping unit has little value for farming.

Soil management unit 5b (IVw); woodland suitability group F.

Au Gres-Roscommon association (Aw).—The soils in this mapping unit are nearly level and sandy. The areas are on plains and consist mainly of low ridges and intervening wet areas. The ridges have side slopes of 1 to 6 percent and are generally less than 10 feet high. Individual ridges are higher and have steeper slopes, and in many areas are fairly long, but they are too narrow to be mapped separately. Included are some flat areas in basins that contain pockets of shallow muck or peat.

The Au Gres and Roscommon soils are sandy throughout. Au Gres soils, on low ridges, are somewhat poorly drained and are mottled at a depth of 6 to 18 inches. Roscommon soils are poorly drained to very poorly drained and have a high water table. They have a thin, dark surface layer that overlies gray sand or strongly mottled sand and are in the lower and more nearly level parts of the areas.

Also in this unit are fairly extensive areas of Saugatuck soils and small areas of the well-drained Rubicon soils. Saugatuck soils are similar to the Au Gres soils, but they have a firmly cemented hardpan at a depth of 8 to 24 inches. Rubicon soils are on some of the higher and steeper ridges. They are brighter colored than the Au Gres soils and are free of mottling to a depth of 3 feet or more.

Problems of drainage, acidity, and infertility make this mapping unit unsuited to farming. The present vegetation is stands of aspen and swamp hardwoods.

Soil management unit 5b (IVw); woodland suitability group F.

[1] Shown as Arenac sand in material published by the Michigan Agricultural Experiment Station.

[2] Shown as Arenac sand in material published by the Michigan Agricultural Experiment Station.

Au Gres-Rubicon association (Ax).—This mapping unit is made up of sandy soils on outwash plains. The areas consist of a series of ridges that have low, level areas in between. The ridges are generally less than 20 feet high and have side slopes of 6 percent or less. Within areas of this mapping unit there are a few small areas on higher ridges and a few, large, level areas.

The Au Gres and Rubicon soils are sandy throughout. Au Gres soils are somewhat poorly drained and are mottled at a depth of 6 to 18 inches. They are in low areas between the ridges. Rubicon soils are well drained and are on the upper slopes and tops of the ridges. They are brighter colored than the Au Gres soils and are free of mottling to a depth of more than 3 feet.

Also in this unit are fairly large areas of the Saugatuck soils and some Roscommon soils. Saugatuck soils are similar to the Au Gres, but they have a firmly cemented hardpan at a depth of 8 to 24 inches. They are nearly level and have a high water table for part of the year. Roscommon soils, on the bottoms of some depressions, are poorly drained to very poorly drained. They have a dark-colored surface layer.

Undulating topography and problems of drainage, acidity, infertility, and droughtiness limit use of areas of this unit for farming. The areas are under second-growth forest in which aspen is dominant.

Soil management unit 5b (IVw); woodland suitability group F.

Belding Series

In the Belding series are moderately dark colored, somewhat poorly drained, level to gently sloping soils. These soils formed in 18 to 42 inches of loamy fine sand to fine sandy loam underlain by limy loam to silty clay loam. The original vegetation was stands of upland and lowland hardwoods that included a few white pines.

Representative profile of Belding loamy fine sand in a cultivated field:

0 to 8 inches, very dark gray, friable loamy fine sand.
8 to 18 inches, dark-brown, friable loamy fine sand.
18 to 20 inches, pale-brown, friable fine sandy loam.
20 to 36 inches, brown, firm clay loam mottled with light brownish gray.
36 to 42 inches +, light-brown, firm, limy, gritty clay loam mottled with light brownish gray.

In cultivated areas a thin gray layer is between the first two layers described. The first three layers range from loamy fine sand to fine sandy loam in texture. These layers together generally range from 18 to 30 inches in thickness, but in a few places they are as much as 42 inches thick. The third layer is very thin or in places is absent. The two layers below range from heavy loam to silty clay loam. Reaction of the first three layers ranges from medium acid to slightly acid, and that of the two layers below ranges from slightly acid to mildly alkaline.

Permeability of these soils is moderately slow. Runoff is slow.

In this county Belding soils occur closely with the Twining soils and are mapped only in complexes with those soils. The complexes are described under the Twining series.

Bergland Series

The Bergland series consists of dark-colored, clayey soils that are very poorly drained. These soils are in level areas or are in basins, and slopes are 2 percent or less. The original vegetation was stands of cedar, ash, elm, soft maple, and other swamp trees.

Representative profile of Bergland mucky loam in a wooded area:

0 to 6 inches, black, friable mucky loam.
6 to 15 inches, black, friable silty clay loam.
15 to 24 inches, light brownish-gray, very firm clay.
24 to 42 inches +, light brownish-gray, very sticky, limy clay mottled with light olive brown.

In some areas as much as a foot of muck is on the surface of these soils. The surface layer in most places is mucky loam or mucky silt loam. The third and fourth layers are clay or silty clay. The boundary between the third and fourth layers, which is at a depth of 16 to 36 inches, marks the top of the limy material. Reaction of the upper three layers ranges from slightly acid to alkaline.

Permeability of these soils is very slow. Runoff is slow to ponded.

These soils are not extensive in this county, and most areas are not farmed.

Bergland mucky loam (Bo).—This is the only Bergland soil mapped in the county. It is wet and has a surface layer of mucky loam or mucky silt loam. A few areas are limy at or near the surface. In a few places as much as 18 inches of muck is on the surface.

Included with this soil in mapping are small areas of Pickford soils, which are slightly better drained than Bergland mucky loam.

Bergland mucky loam is well suited to cultivated crops. Yields are high to moderately high if the soil is artificially drained and is otherwise well managed. This soil is poorly suited to trees. The high water table and the fine texture of the soil severely limit its use for building sites and recreational areas.

Soil management unit 1c (IIIw); woodland suitability group P.

Bohemian Series

Soils of the Bohemian series are light colored and are well drained to moderately well drained. They formed in stratified silt and very fine sand. The original vegetation was northern hardwoods and white pines.

Representative profile of a Bohemian very fine sandy loam:

0 to 3 inches, very dark grayish-brown, very friable very fine sandy loam.
3 to 4 inches, light brownish-gray, very friable fine sandy loam.
4 to 12 inches, brown, friable fine sandy loam.
12 to 17 inches, pale-brown, friable fine sandy loam.
17 to 28 inches, brown, firm silty clay loam.
28 to 60 inches +, thin layers of brown, friable, limy silt and very fine sand.

The texture of the surface layer is loamy fine sand or very fine sandy loam. Below a depth of 28 inches the material consists of several thin layers, each of which has a different texture from that above or below. These layers generally are made up of smooth and silty soil materials. The texture ranges from loamy fine sand to

silt. It is predominantly silt and very fine sand, however, and is somewhat coarser in the loamy fine sands than in the very fine sandy loams. In places the material appears mottled, but the difference in color is between adjacent layers and does not indicate restricted drainage. Slopes range from 0 to 12 percent but are generally from 2 to 6 percent.

In cultivated fields plowing has mixed material from the third layer with the first two layers to form a plow layer. In some areas the first three layers are very thin or are absent. Reaction ranges from slightly acid to alkaline. At a depth of 2 to 4 feet the soils are limy.

Permeability of these soils is moderate. Runoff is slow on the milder slopes and medium on the steeper ones.

Bohemian loamy fine sand, 0 to 2 percent slopes (BbA).—This nearly level soil is moderately well drained. Its profile is coarser textured than the representative profile described for the series. It is loamy fine sand to fine sandy loam to a depth of 15 inches. The texture of the surface layer is dominantly loamy fine sand, but in small areas it is fine sandy loam or silt loam. In a few small areas slopes are more than 2 percent.

Included with this soil in mapping are some low areas of the somewhat poorly drained Brimley soils.

This Bohemian soil is moderately well suited to row crops. Yields range from moderately high to low. The soil is well suited to trees. Limitations to use of the soil for building sites and for recreational areas are few.

Soil management unit 3aA (IIs); woodland suitability group A.

Bohemian loamy fine sand, 2 to 6 percent slopes (BbB).—This gently sloping soil is well drained to moderately well drained. Its profile is coarser textured than the representative profile described for the series. It is loamy fine sand to fine sandy loam to a depth of 15 inches. The texture of the surface layer is dominantly loamy fine sand but is fine sandy loam or silt loam in small areas. Slopes are dominantly between 2 and 6 percent, but they range from 0 to 8 percent in small areas.

Included with this soil in mapping are some low areas of the somewhat poorly drained Brimley soils.

Because of the hazard of erosion, this Bohemian soil is only poorly suited to moderately well suited to crops. Suitable crops are corn, small grain, and hay. Yields are low to moderately high. This soil is well suited to trees. Limitations to use of this soil for building sites and recreational areas are few.

Soil management unit 3aA (IIs); woodland suitability group A.

Bohemian loamy fine sand, 6 to 12 percent slopes (BbC).—This moderately sloping soil is well drained. Its profile is coarser textured than the representative profile described for the series. It is loamy fine sand to a depth of 15 inches. The texture of the surface layer is dominantly loamy fine sand, but it is fine sandy loam or silt loam in small areas.

This soil is droughty and is subject to erosion. It is therefore poorly suited to crops. Field beans and sugarbeets are not adapted to this soil, and any other crops grown make low yields. This soil is well suited to trees. Limitations to use for building sites and recreational areas, other than slope, are slight.

Soil management unit 3aA (IIs); woodland suitability group A.

Bohemian very fine sandy loam, 0 to 2 percent slopes (BcA).—This nearly level soil is moderately well drained. The texture of the surface layer is dominantly very fine sandy loam, but in small areas it is loamy very fine sand, fine sandy loam, or silt loam. In some small areas the slope is more than 2 percent.

Included with this soil in mapping, in the lowest parts of the areas, are somewhat poorly drained Brimley soils.

This Bohemian soil is well suited to crops. Yields of all crops commonly grown in the county are moderately high to high. This soil is also well suited to trees and has no limitations for use for building sites or recreational areas.

Soil management unit 3aA (IIs); woodland suitability group A.

Bohemian very fine sandy loam, 2 to 6 percent slopes (BcB).—This gently sloping soil is well drained to moderately well drained. The texture of the surface layer is dominantly very fine sandy loam, but in small areas it is loamy very fine sand or silt loam. Slopes are dominately between 2 and 6 percent, but they range from 0 to 8 percent in small areas.

Included with this soil in mapping, in some of the lower areas, are somewhat poorly drained Brimley soils.

This Bohemian soil is moderately well suited to crops. Yields and adaptability of crops to this soil varies. Yields of most crops are medium or high, but yields of sugarbeets are low. This soil is well suited to trees and has little or no limitations as a site for buildings or for recreational areas.

Soil management unit 3aA (IIs); woodland suitability group A.

Bowers Series

In the Bowers series are nearly level, moderately dark colored soils that are somewhat poorly drained. These soils formed in silty to clayey deposits laid down in lakebeds. The original vegetation was stands of northern hardwoods.

Representative profile of Bowers loam in a cultivated field:

0 to 7 inches, dark grayish-brown, friable loam.
7 to 13 inches, light brownish-gray, friable silt loam.
13 to 30 inches, brown, firm silty clay loam; contains thin layers of silt loam, clay loam, and sandy loam and is faintly mottled with brown and gray.
30 to 42 inches +, thin layers of pale-brown, firm, limy silty clay loam and clay loam; in places contains thin layers of silt loam, sandy loam, and clay; mottled with grayish brown and yellowish brown.

The surface layer varies in thickness, according to the depth of plowing. It ranges from loam to silty clay loam in texture. The second layer is generally slightly coarser textured than the surface layer. The two layers below each consist of several thin strata. These soils are slightly acid at the surface but are limy at a depth of 22 to 42 inches.

Permeability of those soils is slow to moderate. Runoff is slow.

Bowers loam (Be).—The surface layer of this nearly level soil is dominantly loam, but it is clay loam or sandy loam in small areas. A few places have a thin sandy deposit on the surface. Slopes seldom exceed 2 percent, except in a few small areas.

Included in mapping are small areas of the poorly drained or very poorly drained Hettinger soils in shallow depressions and along natural drainageways.

Bowers loam is well suited to crops, and yields of most crops are high. Artificial drainage is needed, however. This soil is poorly suited to moderately well suited to trees. A seasonal high water table severely limits use of this soil for building sites and recreational areas.

Soil management unit 1.5b (IIw); woodland suitability group Z.

Bowers silty clay loam (Bd).—The surface layer of this nearly level soil is dominantly silty clay loam, but it is silt loam or clay loam in small areas. A few areas have a thin deposit of sand on the surface. Slopes seldom exceed 2 percent, except in a few small areas.

Included with this soil are small areas of the poorly drained or very poorly drained Hettinger soils in shallow depressions and along natural drainageways.

If this Bowers soil is artificially drained, it is well suited to crops, and yields of most crops are high. This soil is poorly suited to moderately well suited to trees. The seasonal high water table severely limits use of this soil for building sites and recreational areas.

Soil management unit 1.5b (IIw); woodland suitability group Z.

Brevort Series

In the Brevort series are dark-colored, poorly drained and very poorly drained soils. These soils formed in sandy deposits underlain by clay loam at a depth of 18 to 42 inches. Lowland hardwoods originally grew on the areas.

Representative profile of Brevort fine sandy loam in a wooded area:

0 to 5 inches, black, friable fine sandy loam.
5 to 10 inches, dark grayish-brown, very friable loamy sand.
10 to 18 inches, grayish-brown, very friable sand.
18 to 24 inches, gray, loose sand.
24 to 42 inches +, brown, firm, limy clay loam mottled with gray.

The texture of the surface layer ranges from sand to fine sandy loam. As much as a foot of muck is on the surface in some wooded areas. In places the mineral surface layer has a mucky feel. The first four layers have a combined thickness of as much as 42 inches in places, but the thickness is generally less than 32 inches. The fourth layer is very thin, or is absent in those places where the thickness of the upper three layers is less than 24 inches. Below is sandy clay loam, clay loam, or silty clay loam that is brown to gray in color. The sandy layers range from slightly acid to neutral.

Permeability is rapid in the sandy part of these soils. It is moderately slow in the clay loam below. Runoff is very slow or is ponded.

Brevort fine sandy loam (Bf).—Most areas of this soil remain in native forest. The surface layer is fine sandy loam, but at a depth of a foot or less the texture is loamy sand or sand. The content of organic matter in the surface layer is fairly high. In some areas a thin layer of muck covers the surface. In small areas the surface layer is mucky loamy sand. Slopes are less than 2 percent in most areas, but they range to 6 percent in a few small areas.

Included with this soil in mapping are small areas of Sims and Hettinger soils in which the sandy material is less than 18 inches thick. Also included are small areas of Roscommon soils in which the sandy material is more than 42 inches thick. A few small areas of limy Essexville soils are also within areas of this mapping unit.

This Brevort soil is moderately well suited to all crops grown in the county, and yields are moderate. Wetness is the chief hazard. This soil is poorly suited to trees. Because of the high water table, use of this soil for building sites or intensive recreational development is severely limited.

Soil management unit 4/2c (IIIw); woodland suitability group W.

Brevort loamy sand (Bn).—Most areas of this nearly level soil have a surface layer of loamy sand, but in small areas the texture is mucky loamy sand, loamy fine sand, or sand. The surface layer is high in organic matter; it is covered by a thin layer of muck in places. Colors in the poorly drained areas are somewhat lighter and mottling is more common than in the very poorly drained areas, which commonly have a darker colored, mucky surface soil. Within the very poorly drained areas are some small swamps and marshes, where water stands much of the year and the vegetation is swamp grasses and cattails.

Included with this soil are small areas of the somewhat poorly drained Iosco soils in some higher lying areas. Also included are small areas of Sims and Hettinger soils, in which sandy material is less than 18 inches thick, and of Roscommon soils, in which sandy material is more than 42 inches thick.

This Brevort soil is moderately well suited to all crops grown in the county, and yields are moderate. Wetness is the chief hazard. This soil is poorly suited to trees. Because of the high water table, use of this soil for building sites or intensive recreational development is severely limited.

Soil management unit 4/2c (IIIw); woodland suitability group W.

Brevort sand (Bo).—The first four layers of this soil consist of sand. The content of organic matter in the surface layer is not so high as in Brevort loamy sand.

Included with this soil in mapping are a few areas of the somewhat poorly drained Iosco soils. Also included are small areas of Sims and Hettinger soils, in which the sand is less than 18 inches thick, and of Roscommon soils, in which sand is more than 42 inches thick.

This Brevort soil is moderately well suited to all crops grown in the county, and yields are moderate. Wetness is the main hazard. This soil is poorly suited to trees. Because of the high water table, use of this soil for building sites or intensive recreational development is severely limited.

Soil management unit 4/2c (IIIw); woodland suitability group W.

Brevort-Kawkawlin association (Br).—This mapping unit is made up of soils in gently undulating areas. Most areas are sandy, and thickness of the sandy material over clay loam glacial till generally varies. Slopes are short and range from 0 to 6 percent. Numerous cradle knolls and small depressions, caused by tree throw, cut the areas. The individual knolls and depressions are generally too small to be mapped separately. Brevort and Kawkawlin soils are dominant, but small areas are occupied by the Sims and Iosco soils.

Brevort soils generally consist of at least 18 inches of sand or loamy sand over clay loam, but in some depressions the sandy material is less than 18 inches thick. Kawkawlin soils formed in clay loam glacial till. They generally consist of loam a foot or less thick over clay loam, but in some areas they are loamy sand to a depth of 8 to 18 inches. Sims soils, also formed in clay loam glacial till, are loamy to a depth of 8 to 18 inches over clay loam. Iosco soils consist of at least 18 inches of sand or loamy sand over clay loam.

Soils in this mapping unit are moderately well suited to all crops grown in the county, and yields are moderate to moderately high. Wetness is the chief hazard. These soils are poorly suited to trees. Use of these soils for building sites or for intensive recreational development is severely limited because of their moderately fine texture.

Soil management unit 4/2c (IIIw); woodland suitability group W.

Brevort-Roscommon association (Bs).—Soils in this mapping unit are dark colored, sandy, and nearly level. These soils are underlain by clay loam glacial till at a depth of 18 to more than 60 inches. The Brevort soils are sandy to a depth of less than 42 inches, and the Roscommon soils are sandy to a depth of more than 42 inches. Depth of the sand varies within a short distance, and the two soils therefore cannot be mapped separately.

Both the Roscommon and Brevort soils are poorly drained to very poorly drained. The texture of the surface layer is loamy sand or mucky loamy sand, and sand underlies these soils at a depth of a foot or less. Below the sand is clay loam glacial till. These soils are medium acid to neutral in the sandy part of the profile, but the loamy glacial till is generally limy.

Soils of this mapping unit are moderately well suited to crops grown in the county. Yields are moderate on the Brevort soils. They are lower on the Roscommon soils, particularly for sugarbeets. Wetness is the major hazard. Also the Roscommon soils are low in fertility and difficult to drain. The soils in this unit are poorly suited to trees. Their use for building sites or for extensive recreational development is severely limited because of the high water table.

Soil management unit 4/2c (IIIw); woodland suitability group W.

Brimley Series

The Brimley series consists of moderately dark colored, somewhat poorly drained soils. These soils formed in deposits of silt and very fine sand. The original vegetation was stands of northern hardwoods that included a few conifers.

Representative profile of Brimley fine sandy loam in a plowed field:

0 to 7 inches, very dark grayish-brown, friable fine sandy loam.
7 to 10 inches, pale-brown, very friable loamy very fine sand.
10 to 15 inches, brown, friable loam.
15 to 25 inches, brown, firm clay loam mottled with strong brown.
25 inches +, thin layers of brown, friable, limy silt and very fine sand mottled with yellowish brown.

The texture of the surface layer is fine sandy loam, loamy fine sand, or loam. In uncultivated areas the surface layer is thinner and darker colored than in cultivated areas. In some cultivated areas the first three layers are mixed together to form a plow layer. A light-colored layer 1 to 2 inches thick is between the third and fourth layers in some places.

The first three layers range from loamy fine sand to silt loam, and their combined thickness is generally less than 18 inches. The fourth layer ranges from silt loam through clay loam to silty clay loam. Below is a layer made up of a number of thinner layers, or strata, each of which has a different texture than the one above or below. In most places the strata are very fine sand or silt, but in a few places they are loamy fine sand, fine sandy loam, silt loam, or silty clay loam. The profile ranges from slightly acid to mildly alkaline to a depth of 18 to 36 inches, but below that depth the soil is limy. Slopes are generally less than 2 percent.

Permeability of these soils is moderate. Runoff is slow.

Brimley fine sandy loam, 0 to 2 percent slopes (BtA).—This nearly level soil is on lake plains. The surface layer is dominantly fine sandy loam, but in some small areas it is sandy loam, loamy fine sand, or silt loam. Slopes seldom exceed 2 percent, except in a few small areas.

Included with this soil in mapping are small areas of the poorly drained Bruce soils, in some depressions and along some minor natural drainageways.

This Brimley soil is moderately well suited to crops, and yields are moderate. The seasonal high water table and the coarse texture of the soil make it somewhat difficult to install an artificial drainage system. This soil is poorly suited to trees. Because of the seasonal high water table, use of this soil for building sites or for intensive recreational development is moderately to severely limited.

Soil management unit 3b (IIw); woodland suitability group G.

Brimley fine sandy loam, 2 to 6 percent slopes (BtB).—This gently sloping soil has slightly better natural drainage than Brimley fine sandy loam, 0 to 2 percent slopes. The surface layer is fine sandy loam in most places, but in some places it is loamy fine sand, loam, or silt loam. Slopes are dominantly between 2 and 6 percent, but they range from 0 to 8 percent in small areas. In a few places a sandy deposit more than 18 inches thick is on the surface.

Included with this soil in mapping are some poorly drained or very poorly drained Bruce soils, in depressions and natural drainageways, and some well-drained Bohemian soils, on small knolls and ridges.

This Brimley soil is moderately well suited to crops, and yields are moderate. The seasonal high water table and coarse texture of the soil make it somewhat difficult to install an artificial drainage system. This soil is poorly suited to trees. Because of the seasonal high water table, use of this soil for building sites or for intensive recreational development is moderately to severely limited.

Soil management unit 3b (IIw); woodland suitability group G.

Brimley loam, 0 to 2 percent slopes (BuA).—This nearly level soil is on lake plains. The upper part of its profile has more silt and clay loam than does the profile described for the series. The surface layer is dominantly loam, but it is sandy loam or silt loam in a few small areas. Slopes are more than 2 percent in a few small areas.

Included with this soil in mapping are small areas of Bruce soils, in some depressions and along some minor natural drainageways.

This Brimley soil is moderately well suited to crops, and yields are moderate. The seasonal high water table and coarse texture make it somewhat difficult to install an artificial drainage system. This soil is poorly suited to trees. Because of the seasonal high water table, use of this soil for building sites or for intensive recreational development is moderately to severely limited.

Soil management unit 3b (IIw); woodland suitability group G.

Brimley loam, 2 to 6 percent slopes (BuB).—This gently sloping soil has slightly better natural drainage than Brimley loam, 0 to 2 percent slopes. The upper part of its profile is finer textured than that in the profile described for the series. The surface layer is loam in most places, but in some places it is fine sandy loam or silt loam. Slopes are dominantly between 2 and 6 percent but range from 0 to 8 percent in small areas.

Included with this soil in mapping are small areas of poorly drained Bruce soils, in depressions and natural drainageways. Also included are some Bohemian soils, on small knolls and ridges.

This Brimley soil is moderately well suited to crops, and yields are moderate. The seasonal high water table and coarse texture make it somewhat difficult to install an artificial drainage system. This soil is poorly suited to trees. Because of the seasonal high water table, use of this soil for building sites or for intensive recreational development is moderately to severely limited.

Soil management unit 3b (IIw); woodland suitability group G.

Brimley loamy fine sand, 0 to 2 percent slopes (BvA).—This nearly level soil is on lake plains. The upper part of its profile is coarser textured than that in the profile described for the series. The surface layer is dominantly loamy fine sand, but it is fine sandy loam or loamy sand in small areas. Slopes seldom exceed 2 percent, except in a few small areas. In places a sandy deposit more than 18 inches thick is on the surface.

Included with this soil in mapping are some poorly drained Bruce soils, in depressions and along minor natural drainageways.

This Brimley soil is moderately well suited to trees, and yields are moderate. The seasonal high water table and coarse texture make it somewhat difficult to install an artificial drainage system. This soil is poorly suited to trees. Because of the seasonal high water table, use of this soil for building sites or for intensive recreational development is moderately to severely limited.

Soil management unit 3b (IIw); woodland suitability group G.

Brimley loamy fine sand, 2 to 6 percent slopes (BvB).—This gently sloping soil has slightly better natural drainage than Brimley loamy fine sand, 0 to 2 percent slopes. The upper part of the profile is coarser textured than that of the profile described for the series. In a few places a sandy deposit more than 18 inches thick is on the surface. The surface layer is loamy fine sand in most places, but in some places it is fine sandy loam or loamy sand. Slopes are dominantly between 2 and 6 percent, but they range from 0 to 8 percent in small areas.

Included with this soil in mapping are small areas of poorly drained Bruce soils, in depressions and natural drainageways, and of well-drained Bohemian soils, on small knolls and ridges.

This Brimley soil is moderately well suited to crops, and yields are moderate. The seasonal high water table and coarse texture make it somewhat difficult to install an artificial drainage system. This soil is poorly suited to trees. Because of the seasonal high water table, use of this soil for building sites or for intensive recreational development is moderately to severely limited.

Soil management unit 3b (IIw); woodland suitability group G.

Bruce Series

In the Bruce series are dark-colored, poorly drained to very poorly drained soils. These soils formed in stratified silt and very fine sand. The original vegetation was swamp hardwoods.

Representative profile of Bruce silt loam in a wooded area:

0 to 5 inches, black, friable silt loam; high content of organic matter.
5 to 11 inches, very dark gray, friable loam.
11 to 18 inches, dark-gray, firm clay loam mottled with yellowish brown.
18 to 22 inches, grayish-brown, friable loam mottled with yellowish brown.
22 to 42 inches +, thin layers of brown to gray, friable, limy fine sandy loam, silt, and silt loam.

The surface layer ranges from loamy fine sand to silt loam. The texture of the fifth layer, which consists of many thin layers, varies within a short distance. The layers are mainly silt loam, silt, very fine sand, and very fine sandy loam, but in many places are sand, loamy sand, sandy loam, loam, or silty clay loam. The upper part of the profile is neutral to mildly alkaline, but at a depth of 15 to 30 inches the material is limy.

In places in wooded areas a thin layer of muck is on the surface. In cultivated areas plowing has mixed material from the upper part of the second layer with the first layer to form a dark-gray plow layer.

Permeability of these soils is moderate. Runoff is very slow to ponded.

Bruce fine sandy loam (Bw).—The surface layer of this nearly level or depressional soil is dominantly fine sandy loam. It is sandy loam, however, in large areas and loam and loamy fine sand in small areas. Some small areas are limy at the surface. In small areas the surface is covered with 10 to 12 inches of sand.

Included with this soil in mapping are a few areas of the somewhat poorly drained Brimley soils.

This Bruce soil is moderately well suited to the crops commonly grown in the county. Wetness is the major hazard. This soil is poorly suited to trees. Use of this soil for building sites or for intensive recreational development is severely limited because of the high water table.

Soil management unit 3c (IIw); woodland suitability group W.

Bruce loamy fine sand (Bx).—The surface layer of this nearly level soil is dominantly loamy fine sand, but it is loamy sand or fine sandy loam in small areas. The upper part of the profile is coarser textured than that of the profile described for the series.

Included with this soil in mapping are a few areas of the somewhat poorly drained Brimley soils on low ridges.

This Bruce soil is moderately well suited to the crops commonly grown in the county. Wetness is the major hazard. This soil is poorly suited to trees. Use of this soil for building sites or for intensive recreational development is severely limited because of the high water table.

Soil management unit 3c (IIw); woodland suitability group W.

Bruce silt loam (By).—This nearly level to depressional soil has a surface layer that is dominantly silt loam but that is loam and very fine sandy loam in small areas. Some small areas are limy at the surface.

Included with this soil in mapping are a few areas of the somewhat poorly drained Brimley soils. Also included are a few small areas that have a thin cover of sandy overwash.

This soil is moderately well suited to the crops commonly grown in the county. Wetness is the major hazard. This soil is poorly suited to trees. Use of this soil for building sites or for intensive recreational development is severely limited because of the high water table.

Soil management unit 3c (IIw); woodland suitability group W.

Burleigh Series

The Burleigh soils are dark colored and poorly drained to very poorly drained. These soils are sandy and are underlain by very fine sand and silt at a depth of 18 to 42 inches. The original vegetation was stands of swamp hardwoods, marsh grasses, and sedges.

Representative profile of Burleigh loamy sand in a wooded area:

0 to 8 inches, black, very friable loamy sand that is high in content of organic matter.
8 to 12 inches, very dark grayish brown, very friable loamy sand; faintly mottled.
12 to 25 inches, yellowish-brown, very friable sand mottled with pale yellow.
25 to 42 inches +, light brownish-gray, friable very fine sandy loam, silt loam, and fine sandy loam in thin layers; layers mottled with yellow and dark brown.

In some very poorly drained areas that have never been cleared, there is a layer of black muck on the surface that is 2 to 6 inches thick. The first three layers are sand or loamy sand and have a combined thickness of 18 to 42 inches. The layer below is made up of a number of very thin layers that differ in texture. In some places these thin layers consist of fine sand, fine sandy loam, very fine sandy loam, silt loam, and silty clay loam. The upper three layers are medium acid to neutral. The layer below is generally limy, but in some places it is slightly acid in the upper part. Colors are dull gray in the very poorly drained areas but are brownish in the higher lying areas where drainage is somewhat better. Slopes are 2 percent or less.

Permeability in the upper part of these soils is rapid, but it is moderate in the lower part. Runoff is very slow to ponded.

Burleigh loamy sand (Bz).—This is the only Burleigh soil mapped in the county. It is in nearly level to depressional areas. In a few places a layer of muck more than a foot thick is on the surface. In some small areas the soil is limy at or near the surface. Swamp grasses grow in the wettest areas, which are ponded in many places.

Included in mapping, within some drier areas of this soil, are small areas of the somewhat poorly drained Ingalls soils. Also included are some Bruce soils in areas where depth of sandy material is less than 18 inches, and some Roscommon soils where such material is more than 42 inches deep.

Burleigh loamy sand is moderately well suited to all crops grown in the county. Yields are moderately high to moderate. Wetness is the major hazard. Artificial drainage is difficult to maintain because of the sandiness of the soil. This soil is poorly suited to trees. Use of this soil for building sites or for intensive recreational development is severely limited because of the high water table.

Soil management unit 4c (IIIw); woodland suitability group W.

Carbondale Series

The Carbondale series consists of dark-colored, very poorly drained soils in low areas. These soils consist of friable black muck. The original vegetation was stands of lowland hardwoods that included some cedar, spruce, and tamarack.

Representative profile of Carbondale muck in a wooded area:

0 to 4 inches, black, friable muck.
4 to 14 inches, dark reddish-brown, very friable, fibrous muck.
14 to 60 inches +, black, friable muck.

In many places the profile contains layers of muck or peat that differ in content of woody material, color, or reaction from the layers above and below. In a few places solid logs and pieces of wood surrounded by well-rotted material are in the profile. The organic layers have a total thickness of 42 inches or more. In places below this depth there are mineral layers that are variable in texture. The profile is strongly acid to slightly acid.

Permeability of these soils is moderate. Runoff is very slow or is ponded.

Carbondale muck and peat (Ca).—This is the only Carbondale soil mapped in the county. It has a surface layer of muck or peat. Slopes are generally less than 2 percent.

Included with this soil, where mineral layers of sandy, loamy, or clayey material, respectively, are within 42 inches of the surface, are areas of the Tawas, Linwood, and Willette soils. Also included are a few small areas of Rifle peat, which is strongly acid, and of soils that are alkaline in reaction.

A variety of crops can be grown on Carbondale muck and peat, and yields are high. Small grains and beans, however, do not grow well. Wetness, low fertility, frost, and wind erosion are the main hazards. This soil is poorly suited to trees. Use of this soil for building sites or for intensive recreational development is severely limited because of the high water table and the low bearing capacity of the soil.

Soil management unit Mc (IIIw); woodland suitability group J.

Charity Series

Soils of the Charity series are dark colored, poorly drained to very poorly drained, and limy. These soils formed in clay or silty clay on level plains or in depressions. Stands of swamp hardwoods that included a few conifers made up the original vegetation.

Representative profile of Charity silty clay loam in a cultivated field:

0 to 6 inches, very dark gray, friable, limy silty clay loam; strong granular structure.
6 to 11 inches, grayish-brown, firm, limy silty clay.
11 to 20 inches, light brownish-gray, very firm, limy silty clay; faintly mottled with pale brown.
20 to 42 inches +, light brownish-gray, very firm, limy clay.

In some areas the surface layer is black and is as much as 12 inches thick. The three layers below are clay or silty clay. In some of the wettest areas, mottling is absent. Charity soils are generally limy at the surface, but in a few areas the upper 1 to 10 inches is mildly alkaline.

Permeability of these soils is very slow. Runoff is very slow to ponded.

Charity silty clay loam (Ch).—This is the only Charity soil mapped in the county. It is on broad, nearly level lake and till plains. Slopes are 0 to 2 percent. The texture is silty clay loam to a depth of 8 to 18 inches but is clay or silty clay below that depth. In a few small areas the surface layer is silty clay or is fine sandy loam. In the fine sandy loam, clay or silty clay is at a depth of 8 to 18 inches. Small patches of sandy or loamy overwash are on the surface of this soil in areas along small natural drainageways. In some low areas the surface soil is mucky.

Included with this soil in mapping, in areas where depth to limy material is more than 10 inches, are small areas of the Pickford and Bergland soils.

Charity silty clay loam is well suited to crops, and all crops common to the county can be grown successfully. Wetness and the fine texture of the soil are the major hazards. This soil is poorly suited to trees. Use of this soil for building sites or for intensive recreational development is severely limited because of the high water table and slow permeability.

Soil management unit 1c (IIIw); woodland suitability group P.

Dawson Series

In the Dawson series are extremely acid, very poorly drained peats. These soils consist of remains of sphagnum moss, reeds, sedges, leatherleaf, and other plants. They are underlain by sand at a depth of 12 to 42 inches. The original vegetation was mainly sphagnum moss and leatherleaf but included a few black spruce and tamarack. These soils are in leatherleaf bogs.

Representative profile in a leatherleaf bog:

0 to 4 inches, dark grayish-brown, fibrous peat.
4 to 20 inches, dark reddish-brown peat.
20 to 42 inches +, gray, loose sand.

The layers of peat are mostly remains of sphagnum moss in which individual plants can still be seen. They range from 12 to 42 inches in thickness and are underlain by sand or loamy sand. Layers of loamy or clayey material occur in places at a depth below 42 inches. These soils are extremely acid, and therefore few plants other than those native to the county grow well on them.

Permeability of these soils is moderately rapid, but the water table is high and the soils are therefore generally saturated. Runoff is very slow to ponded.

In this county Dawson soils occur closely with the Greenwood soils and are mapped only in a complex with those soils. A representative profile of the Greenwood soils is described under the Greenwood series.

Dawson-Greenwood peats (Dg).—This mapping unit is in closed depressions, or basins, in leatherleaf bogs. The peat is generally thickest at the center of an area and thinnest at the side. The edges of some of the areas are rimmed by peat that is less acid than the peat in other areas of this unit. Areas of this mapping unit remain in their natural condition.

Soil management unit Mc–a (VIIIw); woodland suitability group L.

Deford Series

In the Deford series are dark-colored, poorly drained to very poorly drained soils. These soils consist of thin layers of fine and very fine sand and loamy sand. Stands of swamp hardwoods and black spruce made up the original vegetation.

Representative profile of Deford loamy fine sand in a wooded area:

0 to 5 inches, very dark gray, loose loamy fine sand.
5 to 14 inches, grayish-brown or gray, loose fine sand; strongly mottled.
14 to 27 inches, light-gray, loose fine sand and very fine sand in thin alternate layers.
27 to 42 inches +, light-gray, loose very fine sand.

As much as a foot of black muck or brown peat is on the surface of this soil in some wooded areas. In cultivated fields plowing has mixed material from the second layer with the first layer to form a plow layer. The thin layers of fine sand, very fine sand, and loamy fine sand vary in thickness and order of occurrence within a short distance. In some places thin layers of gravelly or silty material are in all parts of the profile. In a few areas the sandy material is underlain by firm loam, clay loam, or clay at a depth of 42 or more inches. The surface layer ranges from medium acid to mildly alkaline, but the layers below are neutral to limy.

Permeability of these soils is rapid. Runoff is very slow to ponded.

Deford loam (Dm).—Most areas of this nearly level soil are wooded. The surface layer of this soil is high in organic matter. Its texture is sandy loam and fine sandy loam in many areas. In some areas sandy outwash less than 42 inches thick is on the surface. Water stands on the surface in a few areas during wet periods.

Included with this soil in mapping are areas of the somewhat poorly drained Wainola soils on a few small ridges.

If artificial drainage is supplied, Deford loam is suited to the crops commonly grown in the county. Yields of most crops are moderate. Special care is needed when installing tile or constructing ditches for drainage because of the sandiness of the soil.

This soil is poorly suited to trees, and trees are seldom planted. The high water table limits use of the soil for residential development, though grasses and shrubs grow well.

Soil management unit 4c (IIIw); woodland suitability group W.

Deford loamy fine sand (Dn).—This soil is mostly in woodland and pasture, but small acreages are in cultivated crops. The areas are nearly level and are on outwash plains. The surface layer of this soil is generally loamy fine sand and loamy sand, but it is fine sandy loam in small areas. In some places sandy outwash less than 42 inches thick is on the surface, and in other areas more than a foot of muck or peat is on the surface. On some small ridges drainage is somewhat poor and the upper 3 feet of the profile is dominantly medium and coarse sand. The lowest areas are ponded during wet periods in places.

Included with this soil in mapping are small areas of the somewhat poorly drained Wainola soils in some of the higher lying areas within this soil.

If artificial drainage is supplied, Deford loamy fine sand is suitable for the crops commonly grown in the county. Yields are low to moderately high, depending on the crops grown. Special care is needed when installing tile or constructing ditches for drainage because of the sandiness of the soil.

This soil is poorly suited to trees, and trees are seldom planted. The high water table limits use of the areas for residential development, though grasses and shrubs grow well.

Soil management unit 4c (IIIw); woodland suitability group W.

Duel Series

The Duel series consists of light-colored, well drained and moderately well drained soils. These soils are composed of sandy material and are underlain by limestone bedrock at a depth of 18 to 42 inches. The original vegetation was stands of sugar maple, beech, and white pine.

Representative profile of Duel loamy sand in an uncultivated area:

0 to 7 inches, gray, very friable loamy sand.
7 to 21 inches, brown, very friable loamy sand.
21 inches +, light-gray, hard limestone bedrock.

In plowed fields the first two layers have been mixed together to form a gray plow layer. The profile ranges from 18 to 42 inches in thickness, and near a depth of 42 inches a layer of pale-brown sand is above the bedrock. In a few places a thin layer of sticky sandy loam occurs between the sandy material and the bedrock. The upper two layers range from loamy sand or loamy fine sand to sand or fine sand in texture and contain fragments of bedrock in a few places. In the moderately well drained areas, mottling occurs just above the bedrock in places. Slopes are mainly less than 6 percent but are as much as 12 percent in places.

Permeability is rapid in the upper layers of these soils, but the bedrock is relatively impermeable. Runoff is slow on the mild slopes and medium on the others.

Duel loamy sand, 0 to 2 percent slopes (DuA).—This nearly level soil is moderately well drained. In a few areas it is underlain by shale at a depth of 18 to 42 inches. The texture of the surface layer is loamy fine sand in a few areas. In a few cultivated areas, the soil is slightly eroded. In these areas brown material from the original subsoil has been mixed with the upper two layers to form the present plow layer. Slopes are dominantly less than 2 percent, but in some small areas they are as much as 4 percent.

Included with this soil in mapping are minor areas of somewhat poorly drained soils. Also, included, where depth to limestone is less than 18 inches and in a few places where it is more than 42 inches, are small areas of the Summerville soils.

Shallowness to bedrock makes this Duel soil poorly suited to cultivated crops. Only a limited number of crops can be grown, and yields are low for these. This soil is poorly suited to trees. Use of the areas for residential development is severely limited because of the shallowness to bedrock.

Soil management unit 4/RaABC (IVs); woodland suitability group T.

Duel loamy sand, 2 to 6 percent slopes (DuB).—This gently sloping soil is well drained and moderately well drained. In a few areas it is underlain by shale at a depth of 18 to 42 inches. The soil is slightly eroded in a few cultivated areas. In these areas brown material from the original third layer has been mixed with the upper two layers by plowing to form the present plow layer. Slopes are dominantly between 2 and 6 percent but range from 0 to 8 percent in some small areas.

Included with this soil in mapping are minor areas of somewhat poorly drained soils. Also included, where depth to limestone is less than 18 inches and in a few places where it is more than 42 inches, are small areas of the Summerville soils.

The slope and shallowness to bedrock make this Duel soil poorly suited to cultivated crops. Only a limited number of crops can be grown, and yields of these are low. There is some hazard of erosion from water or wind. This soil is not well suited to trees. The shallowness to bedrock severely limits use of the areas for residential development.

Soil management unit 4/RaABC (IVs); woodland suitability group T.

Duel loamy sand, 6 to 12 percent slopes (DuC).—This moderately sloping soil is well drained. Its surface layer is loamy fine sand in a few areas. In a few cultivated areas the soil is slightly eroded. In these areas brown material from the original third layer has been mixed with the upper two layers to form the present plow layer. Slopes are dominantly between 6 and 12 percent but range outside these limits in small areas.

Included with this soil in mapping, where depth to limestone is less than 18 inches, are areas of the Summerville soils. Also included are a few limestone outcrops.

The slope and shallowness to bedrock make this Duel soil poorly suited to cultivated crops. Yields of any crop grown are low to very low. If this soil is cultivated, the hazard of erosion is severe because of nearness of bedrock to the surface. Practices are therefore needed to help control erosion. This soil is not well suited to trees. Use of the areas for residential development is severely limited because of shallowness to bedrock.

Soil management unit 4/RaABC (IVs); woodland suitability group T.

Eastport Series

Soils of the Eastport series are light colored and well drained to moderately well drained. These soils consist of deep deposits of sand on beach ridges and dunes along Lake Huron. They originally supported stands of northern hardwoods and red pines.

Representative profile of Eastport sand:

0 to 4 inches, grayish-brown, very friable sand.
4 to 22 inches, yellowish-brown, loose sand.
22 to 36 inches, brownish-yellow, loose sand.
36 to 60 inches +, pale-brown, loose sand.

In small cultivated areas material from the upper part of the second layer has been mixed with the first layer by plowing to form a plow layer. The profile is dominantly medium sand throughout but in places includes thin layers of fine sand, coarse sand, or gravel. The third layer ranges from 10 to 20 inches in thickness and in a few places contains a few weakly cemented chunks of material. The fourth layer is faintly mottled in areas where natural drainage is moderately good. The profile ranges from slightly acid to moderately alkaline throughout. In a few places the lower profile is limy.

Permeability of these soils is rapid. Runoff is slow on the milder slopes and medium on the others.

In this county Eastport soils are mapped only in complexes with the Rubicon soils or with the Rubicon and Roscommon soils. Descriptions of the Rubicon and Roscommon soils are provided under their respective series.

Eastport-Rubicon sands, 0 to 6 percent slopes (ErB).—This complex is on low beach ridges and dunes along the shore of Lake Huron. The areas have a corrugated appearance and in most places have side slopes of 2 to 6 percent. These soils consist of about equal parts of Eastport and Rubicon soils. The Rubicon soils are more acid than the Eastport soils and have a darker colored third layer. Thus the subsoil of soils in this mapping unit ranges from light reddish brown to strong brown in color.

These soils are droughty, and their fertility is low. They therefore are not used for crops. Areas of this complex are moderately well suited to pines but are poorly suited to other trees. Limitations to use of the areas for residential and recreational development are few, other than the difficulty of maintaining a cover of grass because of low moisture-holding capacity and fertility.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Eastport-Rubicon sands, 6 to 12 percent slopes (ErC).—These soils are moderately sloping and are well drained. Much of the original surface layer has been removed through erosion. Consequently in 20 to 40 percent of some areas, the present surface layer consists mainly of material from the original subsoil of the soil profile. In fairly large areas little or no erosion has taken place, and in minor areas the soils are moderately eroded. In some areas the soils are underlain by a layer of loamy or clayey material at a depth of 42 to 60 inches. In a few areas the profile contains much fine sand. Slopes are dominantly between 6 and 12 percent but range outside these limits in small areas.

Droughtiness and low fertility make these soils unsuitable for crops. These soils are moderately well suited to pines but poorly suited to other trees. The slope limits use of the areas for residential and recreational development. It is also difficult to keep a cover of grass on these soils.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Eastport-Rubicon sands, 6 to 12 percent slopes, moderately eroded (ErC2).—These soils are moderately sloping and are well drained. Much of the original surface layer has been removed through erosion. Consequently in more than 40 to 80 percent of the areas, the present surface layer is mainly material from the original subsoil of the soil profile. Fairly large areas are slightly eroded, and minor areas are severely eroded and have blowouts. In small areas a layer of loamy or clayey material is at a depth of 42 to 60 inches. In a few areas the profile contains much fine sand. Slopes are dominantly between 6 and 12 percent but range outside these limits in small areas.

Because of the slope, hazard of erosion, droughtiness, and low fertility, these soils are not suited to crops. They are moderately well suited to pines but poorly suited to other trees. The slope limits use of the areas for residential and recreational development. It is also difficult to keep a cover of grass on these soils.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Eastport-Rubicon sands, 12 to 18 percent slopes (ErD).—This complex consists of equal parts of Eastport and Rubicon soils. Slopes are moderately steep. In places much of the original surface layer has been removed through erosion. Consequently in 20 to 40 percent of the area, the present surface layer is mainly material from the original subsoil of the soil profile. Fairly large areas are not eroded or are slightly eroded, and minor areas are moderately eroded. In some areas the profile contains much fine sand. Slopes are dominantly between 12 and 18 percent but range outside these limits in small areas.

Because of the slope, droughtiness, and low fertility, these soils are not suited to crops. They are moderately well suited to pines but poorly suited to other kinds of trees. The slope severely limits use of the areas for residential and recreational development. It is also difficult to keep a cover of grass on these soils.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Eastport-Rubicon sands, 12 to 18 percent slopes, moderately eroded (ErD2).—This complex consists of equal parts of Eastport and Rubicon soils. Slopes are moderately steep. Much of the original surface layer has been removed through erosion. Consequently in 40 to 80 percent of the area, the present surface layer is mainly material from the original subsoil of the soil profile. Large areas are slightly eroded, and minor areas are severely eroded and have blowouts. In some places the profile contains much fine sand. Slopes are dominantly between 12 and 18 percent but range outside these limits in small areas.

The steep slope, erosion, droughtiness, and low fertility make these soils unsuitable for crops. They are moderately well suited to pines but poorly suited to other trees. The blowouts must be stabilized before planting trees or before other cover can be established. The

slope severely limits use of the areas for residential and recreational development. It is also difficult to keep a cover of grass on the areas.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Eastport-Rubicon sands, 18 to 25 percent slopes, moderately eroded (ErE2).—This complex consists of equal parts of Eastport and Rubicon soils. Slopes are steep. These soils are well drained. Much of the original surface layer has been removed through erosion in 20 to 40 percent of the areas. In these eroded areas the present surface layer is partly material from the original subsoil of the soil profile.

Steep slopes, erosion, droughtiness, and low fertility make these soils unsuitable for crops. They are moderately well suited to pines but poorly suited to other trees. Because of the slope, it is likely that planting of trees will be somewhat difficult. The steep slope also severely limits use of the areas for recreational and residential development. Keeping a cover of grass on the areas is also difficult.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Eastport-Rubicon sands, 25 to 45 percent slopes (ErF).—This complex consists of equal parts of very steep Eastport and Rubicon soils. These soils are well drained. A few areas are eroded. In these areas material from the original subsoil of the soil profile makes up part of the present surface layer. A few small areas have slopes of less than 25 percent.

Because of the slope, droughtiness, and low fertility, these soils are not suited to crops. They are moderately well suited to pines but poorly suited to other trees. The steep slope makes it impractical to use machines for planting trees. It also severely limits use of the areas for residential or recreational development.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Eastport-Rubicon association, rolling (EsC).—This mapping unit is made up of Eastport and Rubicon soils on a series of low beach ridges. The ridges are 3 to 8 feet high and have side slopes of 6 to 10 percent. Both soils are well drained to moderately well drained. They formed in deposits of sand or gravelly sand more than 5 feet thick. The Eastport soils are less acid than the Rubicon soils.

In narrow strips between the ridges are narrow areas of the somewhat poorly drained Au Gres soils. The Au Gres soils comprise less than 10 percent of the area. They have a darker colored surface layer than the Rubicon or Eastport soils and are mottled at a depth of about 18 inches. Like the Eastport and Rubicon soils, the profile of the Au Gres soils is dominantly medium sand, but its lower part commonly contains thin layers of fine sand, coarse sand, or gravel. Also gravel occurs in the layers of sand.

The soils in this mapping unit are not suited to crops, because of slope, low fertility, and droughtiness, and the kind of topography. Better drained areas of these soils are moderately well suited to pines but poorly suited to other trees. Before areas of this unit are used for residential or recreational development, a study of the particular site is needed to determine if it is too wet for such purposes.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Eastport-Rubicon-Roscommon association, undulating (EtB).—This mapping unit is on a series of low beach ridges that parallel the shore of Lake Huron. The ridges are about 3 to 5 feet high and have side slopes of 2 to 5 percent. They are separated by narrow, wet strips that are 5 to 40 feet wide.

The Eastport and Rubicon soils are on the tops and upper slopes of the ridges. In the low areas between the ridges are the Roscommon soils. The Eastport and Rubicon soils are well drained to moderately well drained, but the Roscommon soils are poorly drained to very poorly drained. Eastport soils are less acid than the Rubicon soils.

On the lower slopes of the ridges, and in places extending to the top of some of the lower ridges, are areas of the somewhat poorly drained Au Gres soils. Au Gres soils comprise less than 10 percent of areas of this unit. They are moderately dark colored and are mottled at a depth of about 18 inches. The surface layer is black, and the sand below is gray. A few wet areas are occupied by the Brevort soils. These soils consist of sand underlain by finer textured glacial till at a depth of 18 to 42 inches.

The Eastport, Rubicon, Roscommon, and Au Gres soils formed in deposits that consisted mainly of medium sand but that included thin layers of fine sand, coarse sand, or gravel in the lower part. In addition the layers of sand contained gravel in places. The surface layer of all of these soils is generally sand, but that of the Roscommon soils is mucky in many places.

This unit is made up of droughty and infertile soils that are dry in some places and wet in others. It is therefore unsuitable for crops, and its use for trees is limited. The higher lying areas on the wide ridges have only minor limitations for residential development. A few areas are suitable for recreational development.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Edwards Series

The Edwards series consists of dark-colored, very poorly drained, mucky soils that are underlain by marl at a depth of 12 to 42 inches. Lowland hardwoods and white-cedars were the original vegetation.

Representative profile of Edwards muck:

0 to 16 inches, black, very friable, limy muck.
16 to 22 inches, very dark-brown, very friable, limy muck.
22 to 42 inches +, grayish-brown marl and thin streaks of muck.

The organic material above the marl is finely divided muck but contains a branch or log in a few places. The marl varies in purity and is light gray to brownish gray in color. In a few places thin layers of muck or of mineral material are in the marl. Some areas are fairly dry on the surface. The soils are generally limy to the surface, but where the depth to marl approaches 42 inches, the surface layer is mildly alkaline.

Permeability of these soils is moderate. Runoff is slow or is ponded.

Edwards muck (Eu).—This is the only Edwards soil mapped in the county. It is in nearly level or depressional

areas on lake and outwash plains. The muck in the depressions generally is shallowest at the edges and thickest toward the center.

Included with this soil are large areas of Warners soil that are less than 12 inches thick over marl. Also included are several small areas in which the marl is underlain by sandy to clayey material at a depth of less than 42 inches and the layer of marl is as thin as 8 inches.

Because marl is near the surface, Edwards muck is poorly suited to crops. Excess water must be removed before the areas can be cropped, and the marl makes drainage difficult. This soil is also poorly suited to trees. The high water table severely limits use of the soil for residential and recreational sites.

Soil management unit M/mc (IVw); woodland suitability group J.

Epoufette Series

In the Epoufette series are dark-colored, poorly drained soils. These soils are sandy. They are underlain by gravel and coarse sand at a depth of 18 to 42 inches. The original vegetation was stands of white-cedar, black spruce, and lowland hardwoods.

Representative profile of Epoufette sandy loam in a cultivated area:

0 to 8 inches, black, very friable sandy loam.
8 to 26 inches, grayish-brown, very friable loamy sand; many mottles of reddish yellow and light yellowish brown.
26 to 32 inches, grayish-brown, friable gravelly sandy loam; mottles of reddish yellow and light gray.
32 to 42 inches +, grayish-brown, loose, limy sand and gravel.

The surface layer is thicker than plow depth in some areas. A few wooded areas have a thin layer of muck on the surface. The surface layer is generally sandy loam to a depth of less than a foot. The third layer is absent in many areas, but where present it ranges from 1 to 12 inches in thickness and is heavy sandy loam, gravelly sandy loam, or heavy loamy sand in texture. The proportion of sand and gravel in the fourth layer varies, as does the size of gravel, with increasing depth and from place to place. It is therefore necessary to inspect each area to determine the commercial value of the gravel. Loamy or clayey material is at a depth of 42 or more inches in places.

Permeability of these soils is moderately rapid. Runoff is very slow or is ponded. The moisture-supplying capacity is moderate.

Epoufette sandy loam (Ew).—This is the only Epoufette soil mapped in the county. It is nearly level and is on outwash plains. The texture of the surface layer is sandy loam in most areas but is loamy fine sand in places. In small areas a layer of loamy or clayey material underlies the loose sand and gravel at a depth of less than 42 inches. Slopes exceed 2 percent in a few areas.

Included with this soil are a few small areas of the somewhat poorly drained Gladwin soils on ridges.

Epoufette sandy loam is moderately well suited to cultivated crops. Yields are moderate for some crops and low for others. Before crops can be successfully grown, artificial drainage is needed. Sandiness, however, makes it difficult to install tile or open ditches for drainage and to maintain them. This soil is poorly suited to trees. The high water table severely limits use of the soil for residential or recreational sites.

Soil management unit 4c (IIIw); woodland suitability group W.

Essexville Series

Soils of the Essexville series are dark colored, very poorly drained, and limy. They are sandy and are underlain by loamy material at a depth of 18 to 42 inches. The original vegetation was stands of alders, willows, sedges, and marsh grasses.

Representative profile of Essexville loamy fine sand in an uncultivated area:

0 to 9 inches, black, very friable, limy loamy fine sand.
9 to 16 inches, light brownish-gray, loose, limy sand.
16 to 34 inches, light brownish-gray, loose, limy sand mottled with yellowish brown.
34 to 42 inches +, gray, firm, limy clay loam mottled with yellowish brown and reddish brown.

In some areas a layer of muck 2 to 8 inches thick is on the surface. The surface layer is black and ranges from 4 to 12 inches in thickness. The upper three layers combined range from 18 to 42 inches in thickness and from sand and fine sand to loamy fine sand in texture. The material below is clay loam and sandy clay loam to silty clay loam.

Permeability of these soils is rapid in the upper sandy part of the profile and moderately slow in the underlying finer textured layer. Runoff is slow to ponded.

Essexville loamy fine sand (Ex).—This is the only Essexville soil mapped in the county. It is nearly level and wet. Slopes are 2 percent or less.

Included with this soil are a few areas of Brevort soils that are more than 10 inches thick over limy material and of Tobico soils that are sandy to a depth of more than 42 inches over finer textured material. Also included are areas of Wisner soils that are sandy to a depth of less than 18 inches.

Essexville loamy sand is moderately well suited to cultivated crops. Yields are moderately low. Artificial drainage is needed before the areas can be cropped. The soil is sandy, and special care is needed when installing tile or constructing open ditches for drainage. The surface layer is alkaline and in many places lacks sufficient manganese for such crops as oats and navy beans. This soil is poorly suited to trees. The high water table severely limits use of the areas for residential or recreational development.

Soil management unit 4/2c (IIIw); woodland suitability group W.

Fresh Water Marsh

Fresh water marsh (Fm) is in partly submerged swamps along the shore of Lake Huron. It consists of a mixture of soil materials. Some of the material was washed into the lake from land areas, and some was washed onto the shore by waves. The vegetation is cattails and reeds.

This land type is of little economic value, except to provide areas for ducks. Launching of boats along the shore causes problems.

Soil management unit Sc (VIIIw); not suitable for trees, and therefore not placed in a woodland suitability group.

Gladwin Series

In the Gladwin series are dark-colored, somewhat poorly drained soils. These soils consist of sandy and gravelly material from outwash deposits. The original vegetation was stands of northern hardwoods that included some white pines and hemlocks.

Representative profile of Gladwin loamy sand in a cultivated field:

0 to 8 inches, very dark gray, very friable loamy sand.
8 to 12 inches, pale-brown, very friable sand.
12 to 23 inches, brown, very friable loamy sand; mottles of gray and dark brown.
23 to 29 inches, light yellowish-brown, friable gravelly sandy loam; mottles of gray and very dark brown.
29 to 42 inches +, pale-brown, loose, limy sand and gravel.

In undisturbed areas the surface layer is thinner than described and is black. The third layer lacks mottles in places. The fourth layer is gravelly sandy loam or loamy sand 4 to 10 inches thick. It is limy in some areas and contains variable amounts of gravel. The amount and color of mottling vary greatly. Depth to limy sand and gravel ranges from 18 to 42 inches. The amount of gravel and its size vary considerably with increasing depth and within a short distance. It therefore is necessary to inspect each area to determine the commercial value of the gravel in a particular site. The upper part of the profile is slightly acid to alkaline, but the underlying sand and gravel are limy in most places.

Permeability of these soils is rapid. Runoff is slow.

Gladwin loamy sand (Gm).—This soil is nearly level. In a few places the outwash in which the soil formed is less than 5 feet thick and loamy to clayey material is at a depth of 42 to 66 inches. The texture of the surface layer is sand in a few places. In a few areas the layer of gravelly sandy loam is lacking. Slopes are more than 2 percent in small areas.

Included in mapping are some of the poorly drained Epoufette soils in small shallow depressions. Also included are moderately well drained Mancelona soils on a few knolls and ridges.

This Gladwin soil is moderately well suited to crops. Yields range from moderate to low, depending on the crop. In some places drainage is needed. Sandiness of the soil, however, causes difficulty in installing tile drains in some areas. This soil is also moderately well suited to trees. Because of the fluctuating water table, use of the soil for building sites is somewhat limited.

Soil management unit 4b (IIIw); woodland suitability group G.

Gladwin-Allendale association, undulating (GnB).—This mapping unit is on a series of terraces on both sides of the valley of the Rifle River, northwest of Omer. The terraces are at several levels. Their tops are nearly level, and slopes are less than 6 percent. The breaks from one terrace level to the other have short complex slopes that in places are as much as 15 percent and vary within a short distance. The soils in this unit are mainly of the Gladwin and Allendale series. Other included soils are on higher knolls and steeper slopes and in depressions, natural drainageways, and seeps. All of the areas are too small and intermingled to be mapped separately.

The soils that make up this unit all consist of sandy and gravelly material from outwash and are underlain by lake-laid clay and silty clay at a depth of 1½ to more than 5 feet. The outwash varies in texture and depth within a short distance.

The Gladwin and Allendale soils are sand or loamy sand 18 to 42 inches thick. Gladwin soils are underlain by limy sand and gravel, and Allendale by clay or silty clay. The nearby Au Gres soils consist of sand 42 to 60 inches thick, and the Wainola of alternate layers of sand, loamy sand, and fine sand more than 60 inches thick. All of these soils are somewhat poorly drained and have a surface layer of sand or loamy sand.

Small areas of Mancelona, Manistee, Rubicon, and Rousseau soils are on the higher knolls and steep slopes. In texture these soils are similar to the Gladwin, Allendale, Au Gres, and Wainola soils, respectively. Their drainage is good to moderately good. In depressions, natural drainageways, and seeps are the Epoufette, Pinconning, Roscommon, and Deford soils. These soils are poorly drained. The upper part of the profile of some soils is similar to that of the Mancelona, Gladwin, or Epoufette soils, but clay or silty clay is at a depth of 18 to 60 inches.

Little of this mapping unit is used for crops because the areas of the various kinds of soils that make up the unit are too small and intermingled. Also the low wet areas are difficult to drain. The areas are moderately well suited to trees.

Soil management unit 4b (IIIw); woodland suitability group G.

Gravel and Sand Pits

Gravel and sand pits (Gp) consists of areas from which so much sand and gravel have been removed that the soil profile cannot be identified. The areas shown on the maps are those present at the time of mapping. Other pits are likely to be dug in the future, and some of those shown may be filled in.

This land type is not suitable for crops or trees. It therefore is not placed in a soil management unit or woodland suitability group.

Grayling Series

Soils of the Grayling series are light colored and well drained to moderately well drained. These soils are deep and sandy. The original vegetation was stands of scrub oak and jack pine that included a few red pines.

Representative profile of Grayling sand:

0 to 5 inches, grayish-brown sand.
5 to 23 inches, yellowish-brown, very friable, loose sand.
23 to 60 inches +, light yellowish-brown, loose sand.

In undisturbed areas the surface layer is black and is ½ to 3 inches thick. In many places the upper few inches of the second layer is lighter colored than the rest of the layer. In most places the profile is dominantly medium sand, but in places there are thin layers of fine sand, coarse sand, or fine gravel. The profile is slightly acid to strongly acid throughout.

Permeability of these soils is very rapid. Runoff is slow.

Grayling association (Gr).—This mapping unit is on sandy outwash plains. Depth of the sandy material is more than 5 feet. Slopes range from 0 to 18 percent.

They are less than 2 percent in 60 percent of the area, are from 2 to 6 percent in 25 percent of the area, from 6 to 12 percent in 10 percent of the area, and more than 12 percent in 5 percent of the area. The gentle slopes are in broad continuous areas, and the steeper ones are on isolated ridges and in stream cuts. The composition of this unit is less variable than that of the unit having the same name on the general soil map.

Grayling soils are dominant in this mapping unit. They are sandy throughout and are well drained to moderately well drained. These soils are light colored; the contrast between the layers in their profile is faint.

In some depressions and flat areas are the somewhat poorly drained, sandy Au Gres soils. These soils are mottled at a depth of 18 to 36 inches. Included are a few areas of the Rubicon soils. The second layer of these soils is grayer than that in the Grayling soils, and the third layer is redder. In some areas reddish bands of material ⅛ inch to 2 inches thick are in the third layer at a depth below 42 inches. Some of the bands are sand of a different color than described; others are more sticky than the sand above and below and vary in number and depth within a short distance.

Areas of this mapping unit have never been farmed. They have a forest cover of aspens and red oaks of poor quality. Wind erosion is therefore minor, and gullying is not a problem. The soil material is sandy, and runoff is slight because of the very rapid permeability of the sand. Other than the difficulty of keeping a cover of grass on the areas, limitations to use of this mapping unit for building sites are slight.

Soil management unit 5.7aAC (VIIs); woodland suitability group N.

Greenwood Series

In the Greenwood series are very poorly drained, organic soils. These soils are in leatherleaf bogs. They consist of very acid peat 42 inches or more thick. The vegetation in the areas is chiefly sphagnum moss and leatherleaf but includes a few spruce and tamarack trees.

Representative profile of Greenwood peat:

0 to 4 inches, dark grayish-brown, mossy peat.
4 to 44 inches +, dark reddish-brown or yellowish-brown, fibrous peat.

These soils are made up of peat composed largely of the remains of sphagnum moss, the individual plants of which can still be identified. The peat is underlain in a few places by mineral soil material at a depth below 42 inches. These soils are extremely acid, and only a few kinds of plants can tolerate such acidity.

Permeability of these soils is moderately rapid. Runoff is slow to ponded.

Because the areas are small and intricately mixed with areas of Dawson soils, the Greenwood soils are not mapped separately in this county. They are mapped in a complex with the Dawson soils, and the complex is described under the Dawson series.

Gullied Land

Gullied land (Gu) is steep and has many large gullies. All of the original surface layer of sandy loam and part of the subsoil of reddish-brown clay loam have been removed through erosion. Limy parent material is at or near the surface. Most areas of this unit are idle.

Soil management unit 1.5aEF3 (VIIe); woodland suitability group B.

Hettinger Series

The Hettinger soils are dark colored and poorly drained to very poorly drained. These soils consist of silty and clayey material deposited in lakebeds. The original vegetation was mainly elm, ash, and aspen but included a few white pines and hemlocks.

Representative profile of Hettinger clay loam in a wooded area:

0 to 4 inches, very dark grayish-brown, friable clay loam.
4 to 20 inches, gray, firm clay loam.
20 to 42 inches +, layers of pale-brown, massive clay loam, silty clay loam, and very fine sand mottled with yellowish brown and brownish yellow.

In some wooded areas a layer of muck or unrotted plant remains 1 to 6 inches thick is on the surface. In cultivated fields, material from the upper part of the second layer has been mixed with the first layer by plowing to form a dark-gray plow layer. The surface layer is loam to silty clay loam in texture. The third layer consists of several thinner layers, each of which has a different texture, depending on the conditions that prevailed at the time it was laid down in the lakebed. Most of these layers are silty clay loam or clay loam in texture, but in places they are silt loam, silt, very fine sand, sandy loam, clay, or silty clay. The surface layer is neutral to mildly alkaline, and the profile is limy at a depth of 2 feet or less. Yellowish and brownish mottling is common in the poorly drained areas, but mottling in the very poorly drained areas is dull gray. Slopes are generally 2 percent or less.

Permeability of these soils is moderately slow. Runoff is slow to ponded.

Hettinger clay loam (Hc).—This nearly level soil occupies areas where natural drainage is restricted. In a few areas, and especially along natural drainageways, as much as 18 inches of sandy material is on the surface. The surface layer is dominantly clay loam, but in small areas it is silty clay loam or loam.

Included in mapping are the somewhat poorly drained Bowers soils in a few of the higher areas.

Hettinger clay loam is well suited to all crops commonly grown in the county. If artificial drainage is supplied and the soil is otherwise well managed, yields are high. This soil is poorly suited to trees. Because of the high water table, use for building sites is severely limited.

Soil management unit 1.5c (IIw); woodland suitability group P.

Hettinger loam (Hg).—This nearly level soil occupies areas where natural drainage is restricted. In a few areas, and especially along natural drainageways, as much as 18 inches of sandy material is on the surface. The surface layer is dominantly loam, but in small areas it is silt loam or clay loam. In a few small areas slopes are more than 2 percent but generally are not more than 4 percent.

Included in mapping are the somewhat poorly drained Bowers soils in a few higher lying areas.

Hettinger loam is well suited to all crops commonly grown in the county. If artificial drainage is supplied and the soil is otherwise well managed, yields are high. This soil is poorly suited to trees. Because of the high water table, use of the areas for building sites is severely limited.

Soil management unit 1.5c (IIw); woodland suitability group P.

Hettinger silty clay loam (Hn).—This nearly level soil is in areas where natural drainage is restricted. In a few areas, and especially along drainageways, a layer of sandy material as much as 18 inches thick is on the surface. These areas are small and are shown by sand spots on the detailed soil map. The surface layer is dominantly silty clay loam but in small areas is loam or clay loam.

Included in mapping are the somewhat poorly drained Bowers soils in a few higher lying areas.

Hettinger silty clay loam is well suited to all crops commonly grown in the county. If artificial drainage is supplied and the soil is otherwise well managed, yields are high. This soil is poorly suited to trees. Because of the high water table, use of the area for building sites is severely limited.

Soil management unit 1.5c (IIw); woodland suitability group P.

Ingalls Series

Soils of the Ingalls series are moderately dark colored and somewhat poorly drained. These soils are sandy and are underlain by fine sand or silt at a depth of 18 to 42 inches. The original vegetation was stands of red and white pines and northern hardwoods.

Representative profile of Ingalls loamy sand in a wooded area:

0 to 3 inches, dark grayish-brown, very friable loamy sand.
3 to 10 inches, grayish-brown, loose loamy sand.
10 to 30 inches, dark-brown, very friable loamy sand; many yellowish-brown mottles.
30 to 42 inches +, brown, friable, limy very fine sand, silt, silt loam, and silty clay loam in thin layers.

In cultivated fields plowing has mixed all or part of the second layer with the first layer to form a dark-gray plow layer. Texture of the upper three layers is generally sand or loamy sand, but in a few places chunks of cemented material are in the third layer. The upper three layers combined range from 18 to 42 inches in thickness. At a depth of 42 inches, a layer of loose, mottled, brownish-gray sand occurs between the third and fourth layers. The lowest layer varies considerably in texture because it is made up of very thin layers of different textured material, though very fine sand and silt are dominant. The upper three layers range from medium acid to neutral. Limy material is generally in the fourth layer. The upper part of this layer lacks limy material in places, but the lower part is limy. Mottling varies greatly in amount and color, but the sandy part of the profile is generally mottled.

Permeability of these soils is rapid. Runoff is slow.

Ingalls loamy sand, 0 to 2 percent slopes (IgA).—This nearly level soil is somewhat poorly drained. In small areas silt or very fine sand is at a depth below 42 inches. In some small areas silty clay loam to silt loam is dominant in the lowest layer. In a few places plowing has mixed some dark-brown material formerly in the third layer with the surface layer. The texture of the surface layer is dominantly loamy sand, but in small areas it is sand or fine sand. Slopes are more than 2 percent in some small areas.

Included with this soil are Burleigh and Bruce soils in small, shallow depressions and along minor natural drainageways. A few higher areas are occupied by moderately well drained soils. Also included are Brimley soils in which sandy material is less than 18 inches thick.

This Ingalls soil is moderately well suited to most crops commonly grown in the county, and yields are moderate. It is poorly suited to sugarbeets. Drainage is needed in some areas. This soil is moderately well suited to trees. Use of the areas for building sites or recreational sites is somewhat limited.

Soil management unit 4b (IIIw); woodland suitability group G.

Ingalls loamy sand, 2 to 6 percent slopes (IgB).—This gently sloping soil is somewhat poorly drained. In small areas depth to the underlying silt or very fine sand is more than 42 inches. In some small areas silty clay loam to silt loam is dominant in the lowest layer. In a few places plowing has mixed some dark-brown material from the third layer with the surface layer. The texture of the surface layer is dominantly loamy sand, but in small areas it is sand or fine sand. Slopes are dominantly between 2 and 6 percent, but they are outside these limits in small areas.

Included with this soil are Burleigh and Bruce soils in a few, small, shallow depressions and along minor natural drainageways. Also included are Brimley soils in which sandy material is less than 18 inches thick.

This Ingalls soil is moderately well suited to most crops, and yields are moderate. It is not suited to sugarbeets. Drainage is needed in places. This soil is also moderately well suited to trees. Wetness somewhat limits use of the areas for building sites or recreational sites.

Soil management unit 4b (IIIw); woodland suitability group G.

Iosco Series

In the Iosco series are moderately dark colored, somewhat poorly drained soils. These soils are sandy and are underlain by loam to silty clay loam at a depth of 18 to 42 inches. The original vegetation was stands of white pines and northern hardwoods.

Representative profile of Iosco loamy sand in a wooded area:

0 to 8 inches, very dark grayish-brown, very friable loamy sand.
8 to 28 inches, yellowish-brown, very friable loamy sand.
28 to 32 inches, grayish-brown, loose loamy sand mottled with brown.
32 to 42 inches +, grayish-brown, firm clay loam mottled with yellowish brown.

In some wooded areas a thin layer of partly rotted leaves and twigs is on the surface. The upper three layers range from 18 to 42 inches in thickness. The material in these layers is generally very friable to loose, but in a few places in the third layer there are firmly cemented chunks of material. The upper three layers are slightly acid to medium acid. The layer below is slightly acid in the upper part and limy in the lower part. This

layer is loam, sandy clay loam, or silty clay loam in texture; it ranges from nearly red to gray in color; and it is generally mottled.

Permeability of these soils is rapid in the upper part and moderately slow in the lower part. Runoff is slow on the flat areas and medium on the sloping ones.

Iosco loamy sand, 0 to 2 percent slopes (ImA).—This nearly level soil is in low areas where drainage is somewhat restricted. The surface layer is generally loamy sand or loamy fine sand but is sand and fine sand in small areas. Slopes are dominantly less than 2 percent. In a few areas the soil is limy at or near the surface, and in a few other areas yellowish-brown material that formerly was in the subsoil is exposed in newly plowed fields. Colors are grayer in the more poorly drained parts of the area, and browner in the better drained parts.

Included with this soil are Brevort, Hettinger, and Sims soils in small depressions and drainageways. On a few higher knolls and ridges are Menominee and Rubicon soils. Also included are small areas of Bowers, Kawkawlin, and Twining soils, which are sandy to a depth of less than 18 inches, and of Au Gres soils, which are sandy to a depth of more than 42 inches.

This Iosco soil is moderately well suited to crops. Yields are variable, depending on the crop, and artificial drainage is needed before this soil can be cropped satisfactorily. This soil is poorly suited to trees. The fluctuating water table somewhat limits use of the soil for residential and recreational developments.

Soil management unit 4/2b (IIIw); woodland suitability group G.

Iosco loamy sand, 2 to 6 percent slopes (ImB).—This gently sloping soil is on ridges and hillsides. It has slightly better drainage than Iosco loamy sand, 0 to 2 percent slopes. The surface layer is generally loamy sand or loamy fine sand, but it is sand or fine sand in small areas. A few areas are slightly eroded, and here yellowish-brown subsoil is exposed in newly plowed fields.

Included with this soil are Brevort, Hettinger, and Sims soils in shallow depressions and along small natural drainageways. On the higher knolls and ridgetops are Menominee and Rubicon soils. Also included are small areas of Kawkawlin, Bowers, and Twining soils, which are sandy to a depth of less than 18 inches, and of Au Gres soils, which are sandy to a depth of more than 42 inches.

This soil is poorly suited to well suited to the crops grown in the county; it is not suited to sugarbeets. Yields are variable. This soil is moderately well suited to trees. The fluctuating water table somewhat limits use of this soil for building sites or for recreational areas. Some isolated areas might be satisfactory for such uses, but investigation of each site is needed to determine its suitability.

Soil management unit 4/2b (IIIw); woodland suitability group G.

Iosco sand, 0 to 2 percent slopes (IoA).—This soil is in nearly level areas where drainage is somewhat restricted. The surface layer generally is sand or fine sand, but in a few small areas it is loamy sand. A few areas are eroded, and here yellowish-brown material from the subsoil is exposed in newly plowed fields.

Included with this soil are small areas of poorly drained Brevort, Hettinger, and Sims soils in depressions and natural drainageways. On some higher areas are Menominee and Rubicon soils. Also included are small areas of Kawkawlin, Bowers, and Twining soils, which are sandy to a depth of less than 18 inches, and of Au Gres soils, which are sandy to a depth of more than 42 inches.

Little of this soil is now in crops. Yields are moderate to low. Fertilizer is needed, and the content of organic matter must be maintained. Some areas require drainage, but the moderately fine texture of the underlying material, and variation in depth to this material, make it difficult to provide drainage. This soil is poorly suited to trees. The fluctuating water table and the moderately fine texture of the underlying material somewhat limit use of this soil for building sites, recreational areas, and similar purposes.

Soil management unit 4/2b (IIIw); woodland suitability group G.

Iosco sand, 2 to 6 percent slopes (IoB).—This gently sloping soil is on ridges and hillsides. It has slightly better natural drainage than Iosco sand, 0 to 2 percent slopes. The surface layer is dominantly sand, but it is fine sand in small areas. A few small areas are eroded, and here the surface layer is yellowish brown.

Included with this soil are poorly drained Brevort, Hettinger, and Sims soils in depressions and natural drainageways. On the knolls and ridges are Menominee and Rubicon soils. Also included are somewhat poorly drained Bowers, Kawkawlin, and Twining soils, which are sandy to a depth of less than 18 inches, and Au Gres soils, which are sandy to a depth of more than 42 inches.

This soil is poorly suited to crops because of droughtiness, wetness, variable texture, and in places hazard of erosion. It is also poorly suited to trees. The fluctuating water table and sandy nature of the soil somewhat limit use of the areas for building sites and for recreational sites. Some isolated areas might be satisfactory for such uses, but investigation of each site is needed to determine its suitability.

Soil management unit 4/2b (IIIw); woodland suitability group G.

Iosco-Rubicon association, undulating (IrB).—This mapping unit is on undulating, sandy outwash plains. It is underlain by finer textured glacial till at a depth of 18 to 60 inches in most places. The till is limy and is loam, clay loam, or silty clay loam in texture. Slopes are short and are dominantly between 2 and 12 percent, but they are outside this range in a few small areas.

The Iosco and Rubicon soils are dominant in this mapping unit, but small areas are occupied by the Au Gres, Brevort, and Menominee soils. The surface layer of the Iosco, Au Gres, and Brevort soils is sand or loamy sand, but that of the Rubicon and Menominee soils is sand.

Iosco soils are on the lower slopes and in depressions between the knolls and ridges. These soils are somewhat poorly drained. Rubicon soils are on the tops and upper slopes of the knolls and ridges. They are well drained and are underlain by clay loam till at a depth of 42 to 66 inches.

Au Gres soils are somewhat poorly drained and are sandy to a depth of 42 to 60 inches. Brevort soils are dark colored, sandy, and poorly drained or very poorly drained. These soils are in a few large depressions and along minor natural drainageways. They are underlain by clay loam glacial till at a depth of 18 to 42 inches.

Menominee soils are moderately well drained and well drained. They are sandy to a depth of less than 42 inches.

This mapping unit is not suited to crops. The well-drained soils are droughty, and the other soils are wet. The soils also vary in texture within a short distance and are therefore difficult to manage. This mapping unit is poorly suited to trees.

Soil management unit 4/2b (IIIw); woodland suitability group G.

Isabella Series

Soils of the Isabella series are light colored and well drained to moderately well drained. These soils formed in loamy glacial till or in thin deposits of outwash overlying till. The original vegetation was stands of northern hardwoods.

Representative profile of Isabella sandy loam in a plowed field:

0 to 8 inches, gray, friable sandy loam.
8 to 12 inches, light brownish-gray, friable sandy loam.
12 to 32 inches, brown to reddish-brown, firm clay loam.
32 to 42 inches +, brown, firm, limy sandy clay loam.

The first layer is a plow layer formed from the original very dark gray surface layer and a layer of light-gray loamy sand just below. These layers can be seen in undisturbed areas, where a brown layer occurs at a depth of 8 to 10 inches. The texture of the surface layer ranges from loamy sand to sandy loam. Clay loam is at a depth of 18 inches or less. The third layer is clay loam in texture, but the fourth layer is limy and ranges in texture from sandy clay loam to light clay loam. Depth to limy material ranges from 25 to 42 inches. In areas where drainage is moderately good, a few mottles occur in the fourth layer. In this layer there are streaks of very limy material in a few places. These soils range from slightly acid to alkaline.

Permeability of these soils is moderately slow. Runoff is slow on the milder slopes and rapid on the steeper ones.

In this county Isabella soils occur closely with Ubly soils and are mapped only in complexes with those soils. A representative profile of the Ubly soils is described under the Ubly series.

Isabella-Ubly loamy sands, 0 to 2 percent slopes (IuA).—These nearly level soils are on hilltops. They are moderately well drained. The soil material is loamy sand or loamy fine sand to a depth of 10 to 30 inches, and its depth is quite variable within a short distance. In a few small areas, plowing has exposed the dark-brown clay loam that underlies the sandy material. Slopes exceed 2 percent in a few small areas.

Included with these soils are small areas of the Menominee soils. These soils have a surface layer of loamy sand underlain by loose sand to a depth of 18 inches or more. In closed depressions and along minor natural drainageways are the somewhat poorly drained Twining and Belding soils.

The Isabella-Ubly soils are moderately well suited to crops. Yields are moderate for corn, wheat, and oats but low for beans and sugarbeets. These soils are well suited to trees. The moderately slow permeability somewhat limits use of these soils for building sites, recreational areas, and similar purposes.

Soil management unit 1.5aA (IIs); woodland suitability group B.

Isabella-Ubly loamy sands, 2 to 6 percent slopes (IuB).—These gently sloping soils are in the uplands. They are well drained to moderately well drained. The material is loamy sand or loamy fine sand to a depth of 10 to 30 inches, below which is brown clay loam that is within plow depth in a few small areas. In some areas the surface layer of loamy sand has been removed from 40 to 80 percent of the area. Slopes are dominantly between 2 and 6 percent but, in a few small areas they range outside these limits.

In closed depressions and along minor natural drainageways are the somewhat poorly drained Twining and Belding soils. In small areas are Menominee soils that have a surface layer of loamy sand. The material below is sand to a depth of more than 18 inches.

The Isabella-Ubly soils are moderately well suited to crops. Yields of corn, wheat, and oats are moderate, but yields of beans and sugarbeets are low to very low. These soils are well suited to trees. The moderately slow permeability somewhat limits use of these soils for building sites, recreational areas, and similar purposes.

Soil management unit 1.5aB (IIe); woodland suitability group B.

Isabella-Ubly loamy sands, 6 to 12 percent slopes (IuC).—These moderately sloping soils are well drained. The soil material is loamy sand to loamy fine sand to a depth of 10 to 30 inches, below which is clay loam. In a few small areas, much of the loamy sand material has been removed and the present plow layer is partly clay loam. Slopes are dominantly between 6 and 12 percent, but they range outside these limits in small areas.

The slope and hazard of water erosion limit use of these soils for crops. Yields are lower than on less sloping Isabella-Ubly loamy sands, and sugarbeets are not suited. These soils are well suited to trees. Because of slope and moderately slow permeability, use of these soils for building sites, recreational areas, and similar purposes is somewhat limited.

Soil management unit 1.5aC (IIIe); woodland suitability group B.

Isabella-Ubly loamy sands, 12 to 18 percent slopes (IuD).—These moderately steep soils are well drained. The surface layer is loamy sand in most areas, but it is loamy fine sand in small areas. A cover of forest or of grass has protected most areas from erosion, but small areas are eroded. In the eroded areas the present surface layer is reddish-brown clay loam. Slopes are dominantly between 12 and 18 percent, but in small areas they are outside these limits.

These soils are poorly suited to cultivated crops because of the slope and the hazard of water erosion. They are well suited to trees and pasture crops. Because of the slope and moderately slow permeability, use of these soils for building sites, recreational areas, and similar purposes is severely limited.

Soil management unit 1.5aD (IVe); woodland suitability group B.

Isabella-Ubly loamy sands, 25 to 55 percent slopes (IuF).—These soils are steep and are well drained. The texture of the surface layer is generally loamy sand or loamy fine sand, but it is sandy loam in a few areas. A forest cover has protected most areas from erosion, but in a few areas the soils are severely eroded. In the

eroded areas all of the loamy sand has been removed, and the present surface layer is loam or clay loam. In some small areas slopes are less than 25 percent. There are a few wet seep spots on the hillsides.

Because of the steep slopes, these soils are not suited to crops. They are only moderately well suited to pasture crops, but they are well suited to trees. Unless surrounded by smoother slopes, these soils are poorly suited for building sites, recreational areas, or similar purposes.

Soil management unit 1.5aF (VIIe); woodland suitability group B.

Isabella-Ubly sandy loams, 0 to 2 percent slopes (IwA).—These soils are nearly level and are moderately well drained. The surface layer is generally sandy loam or fine sandy loam, but it is loamy sand or loam in small areas. The thickness of the sandy material ranges from 8 to 24 inches. In some cultivated fields the plow layer is sandy loam and rests directly on the layer of clay loam. In a few of these areas, the plow layer contains some clay loam from this layer. Slopes exceed 2 percent in a few areas.

Included with these soils are somewhat poorly drained Twining and Belding soils in small depressions and along narrow natural drainageways.

The Isabella-Ubly soils are well suited to crops, and yields are moderately high if the soils are well managed. Drainage is needed in places in the depressions. These soils are well suited to trees. Because of the moderately slow permeability, use of the soils for residential sites and recreational areas is somewhat limited.

Soil management unit 1.5aA (IIs); woodland suitability group B.

Isabella-Ubly sandy loams, 2 to 6 percent slopes (IwB).—These gently sloping soils are well drained to moderately well drained. The surface layer is generally sandy loam or fine sandy loam, but it is loamy sand or loam in small areas. The sandy material ranges from 10 to 30 inches in thickness. In some cultivated fields the plow layer is sandy loam and rests directly on the layer of clay loam. In a few of these areas, the plow layer contains some clay loam from this layer. Slopes are dominantly between 2 and 6 percent but range outside these limits in a few areas.

Included with these soils are somewhat poorly drained Twining and Belding soils in closed depressions and along minor natural drainageways.

The Isabella-Ubly soils are well suited to crops, and yields are high if the soils are well managed. All of the crops common to the county can be grown successfully. Practices are needed for control of erosion, and in places in the depressions drainage is required. These soils are well suited to trees. Other than the moderately slow permeability, limitations to use of the soils for residential and recreational development are slight.

Soil management unit 1.5aB (IIe); woodland suitability group B.

Isabella-Ubly sandy loams, 2 to 6 percent slopes, moderately eroded (IwB2).—These soils are gently sloping and are well drained to moderately well drained. Erosion has removed all or part of the original layers of sandy loam and loamy sand, and in 40 to 80 percent of the areas, the plow layer consists of material from the layer of clay loam. In more protected areas the plow layer is sandy loam and fine sandy loam.

Included with these soils are somewhat poorly drained Twining soils in low areas.

The Isabella-Ubly soils are moderately well suited to most crops, and yields are moderate. They are not suited to sugarbeets. If the soils are cultivated, they must be protected from erosion. Adding organic material helps to prevent further erosion. In places in the depressions, drainage is needed. These soils are well suited to trees. Because of the moderately slow permeability, use of these soils for residential sites, recreational areas, and similar purposes is somewhat limited.

Soil management unit 1.5aB2 (IIIe); woodland suitability group B.

Isabella-Ubly sandy loams, 6 to 12 percent slopes (IwC).—These soils are moderately sloping and are well drained. The surface layer is sandy loam or fine sandy loam in most areas, but it is loamy sand or loam in small areas. In a few small areas, depth to clay loam is as much as 30 inches, but in other areas clay loam is within plow depth. Slopes are dominantly between 6 and 12 percent but are outside these limits in small areas.

These soils are moderately well suited to most crops. They are not suited to field beans and sugarbeets, because of the slope and hazard of erosion. These soils are well suited to trees. Because of the slope and moderately slow permeability, use of these soils for residential sites, recreational areas, and similar purposes is moderately limited.

Soil management unit 1.5aC (IIIe); woodland suitability group B.

Isabella-Ubly sandy loams, 6 to 12 percent slopes, moderately eroded (IwC2).—These moderately sloping soils are well drained. Erosion has removed much of the original layers of sandy loam, and clay loam is at or near the surface. The present plow layer in 40 to 80 percent of the area consists partly of clay loam. Slopes are dominantly between 6 and 12 percent but are outside these limits in small areas.

These soils are not well suited to cultivated crops, because of slope and erosion. Yields are lower than on the uneroded Isabella and Ubly sandy loams. Field beans and sugarbeets are not suited to these soils. Controlling erosion and supplying additional organic matter helps to prevent further erosion. These soils are well suited to trees. Because of the slope and moderately slow permeability, use of these soils for residential sites, recreational areas, and similar purposes is moderately limited.

Soil management unit 1.5aC2 (IIIe); woodland suitability group B.

Kawkawlin Series

Soils of the Kawkawlin series are dark colored and somewhat poorly drained. They formed in loamy glacial till. The original vegetation was stands of northern hardwoods. Most areas are now in cultivated crops, but some are in hay (fig. 3).

Representative profile of Kawkawlin loam in a cultivated field:

0 to 6 inches, very dark gray, friable loam.
6 to 10 inches, pale-brown, friable loam.
10 to 22 inches, dark-brown, firm, heavy clay loam that breaks to fine blocks; mottled with yellowish brown.
22 to 42 inches +, brown, firm, limy clay loam; many mottles of yellowish brown and light brownish gray.

Figure 3.—**Hay cut from areas of Kawkawlin soils.**

In cultivated areas the first layer is 3 to 4 inches thick and is nearly black in color. In these areas plowing has mixed material from the second layer with the first layer to form a plow layer. The first two layers range from sandy loam to silt loam in texture. Their combined thickness is less than 18 inches. The layer below ranges from dark yellowish brown to brown, is clay loam to light clay, and has well-defined blocky structure. These soils are limy below a depth of 16 to 30 inches but above this depth are slightly acid to neutral. Mottling varies in amount and color and is most common in wet areas.

Permeability of these soils is moderately slow. Runoff is slow.

Kawkawlin loam, 0 to 2 percent slopes (KaA).—This nearly level soil is on till plains. The surface layer is generally loam or silt loam but in small areas is sandy loam or clay loam. Slopes exceed 2 percent in a few small areas.

Included with this soil are Sims soils in depressions and along natural drainageways. Also included are Nester soils on low knolls and ridges.

This Kawkawlin soil is well suited to crops. Yields of all common crops are high if artificial drainage is supplied and the soil is otherwise well managed. This soil is poorly suited to trees. Because of the seasonal high water table, use of these soils for building sites, recreational areas, and similar purposes is severely limited.

Soil management unit 1.5b (IIw); woodland suitability group Z.

Kawkawlin loam, 2 to 6 percent slopes (KaB).—This gently sloping soil is on small knolls and ridges and on the lower slopes of higher hills. It has slightly better natural drainage than Kawkawlin loam, 0 to 2 percent slopes. The surface layer is dominantly loam, but in small areas it is sandy loam, silt loam, and clay loam. Slopes are dominantly between 2 and 6 percent but are less in small areas.

Included with this soil are Sims soils in closed depressions and along minor natural drainageways. Also included are Nester soils on the tops of knolls and low ridges.

This Kawkawlin soil is well suited to all crops commonly grown in the county, and yields are high. Flooding occurs in places in the depressions, and erosion is a hazard

in places on the sloping areas. This soil is poorly suited to trees. Because of the seasonal high water table and flooding in low spots, use of this soil for building sites or recreational areas is severely limited.

Soil management unit 1.5b (IIw); woodland suitability group Z.

Kent Series

Soils of the Kent series are light colored and well drained to moderately well drained. These soils formed in clayey glacial till. Stands of northern hardwoods and white pines made up the original vegetation.

Representative profile of Kent loam in a cultivated field:

0 to 8 inches, grayish-brown, friable loam.
8 to 22 inches, reddish-brown, firm clay; well-defined blocky structure.
22 to 42 inches +, brown, firm, limy clay.

In places the plow layer is thicker than described and contains more material from the second layer because depth of plowing is greater. The second layer is more clayey than the third, which has mottlings and light-colored, limy streaks in a few places. The upper two layers range from slightly acid to mildly alkaline.

Permeability of these soils is slow. Runoff ranges from slow to rapid, depending on the slope.

Kent loam, 0 to 2 percent slopes (KnA).—This nearly level soil is adjacent to stream valleys where slopes seldom exceed 2 percent. It is moderately well drained. In a few places this soil is loamy to a depth of 18 to 24 inches. In some areas the surface layer is sandy loam. The areas of this soil generally are small and are used the same as other soils that surround them.

Included with this soil in mapping are small areas of the somewhat poorly drained Selkirk soils.

This Kent soil is moderately well suited to crops. Yields are moderate to moderately high. The included, wetter soils require drainage in places. This soil is well suited to trees. Use of this soil for building sites and recreational areas is severely limited because of slow permeability.

Soil management unit 1aA (IIIs); woodland suitability group B.

Kent loam, 2 to 6 percent slopes (KnB).—This gently sloping soil is generally adjacent to stream valleys. It is moderately well drained. The surface layer is dominantly loam, but it is silt loam and sandy loam in small areas. In a few areas part of the surface layer has been removed by erosion, and the present plow layer is clay loam. Depth to clay is 18 to 24 inches in some places.

Included in mapping are the somewhat poorly drained Selkirk soils in small depressions and along minor natural drainageways.

This Kent soil is moderately well suited to crops. Yields are somewhat lower than on Kent loam, 0 to 2 percent slopes. Erosion is a hazard. This soil is well suited to trees. Use of this soil for building sites and recreational areas is severely limited because of slow permeability.

Soil management unit 1aB (IIIe); woodland suitability group B.

Kent loam, 6 to 12 percent slopes (KnC).—This moderately sloping soil is on the sides of hills. It is well drained to moderately well drained. The soil is generally loamy to a depth of 6 to 18 inches, but in a few small areas, clay is within plow depth. In some small areas the surface layer is sandy loam.

This soil is moderately well suited to crops, and yields are moderate to moderately high if water erosion is controlled. Field beans and sugarbeets are not suited. This soil is well suited to trees. Slopes and slow permeability severely limit use of the areas for building sites and recreational sites.

Soil management unit 1aC (IIIe); woodland suitability group B.

Lacota Series

In the Lacota series are moderately dark colored, poorly drained to very poorly drained soils. These soils are loamy and are underlain by sand and gravel at a depth of 18 to 42 inches. The original vegetation was stands of oak, elm, ash, and red maple.

Representative profile of Lacota loam:

0 to 8 inches, very dark gray, friable loam.
8 to 34 inches, gray, firm, clay loam mottled with yellowish brown.
34 to 42 inches +, light brownish-gray, loose, limy sand.

The thickness of the first layer is greater than depth of plowing in a few areas. In some areas the surface layer is mucky, and in other areas thin layers of muck are on the surface. The upper two layers combined range from 18 to 42 inches in thickness but are dominantly 20 to 36 inches thick. Their texture is loam, sandy clay loam, clay loam, or silty clay loam. The fourth layer ranges from sand to loamy sand and in places has thin seams of sandy loam. The amount and color of mottling vary. This soil is neutral or slightly acid to a depth of about 2 feet, but it is alkaline below. Slopes are less than 2 percent.

Permeability of these soils is moderately slow. Runoff is very slow to ponded.

Lacota loam (La).—This nearly level soil is on outwash plains. Its surface layer is dominantly loam, but it is sandy loam or clay loam in small areas.

Included with this soil are some poorly drained or very poorly drained Hettinger and Sims soils, in which the upper three layers are more than 42 inches thick or sandy material is within 18 inches of the surface. Also included are a few areas of somewhat poorly drained soils, pockets of muck in some of the lowest areas, and some very small ridges that have slopes of more than 2 percent.

Lacota loam is well suited to crops, and all crops common to the county can be grown successfully. Yields are high if artificial drainage is provided and the soil is otherwise well managed. The sandy underlying layer makes the soil easy to drain, but it also makes it difficult to install tile drains and to maintain open ditches. This soil is poorly suited to trees. The high water table severely limits use of the soil for building sites or for recreational areas.

Soil management unit 1.5c (IIw); woodland suitability group W.

Lacota sandy clay loam (Lb).—This nearly level soil is on outwash plains. Its surface layer is dominantly sandy clay loam, but it is sandy loam or clay loam in small areas.

Included with this soil are some poorly drained or very poorly drained Hettinger and Sims soils, in which the upper two layers are more than 42 inches thick or sandy material is within 18 inches of the surface. Also included are a few areas of somewhat poorly drained soils, pockets of muck in some of the lowest areas, and some very small ridges that have slopes of more than 2 percent.

Lacota sandy clay loam is well suited to crops, and all crops common to the county can be grown successfully. Yields are high if artificial drainage is provided and the soil is otherwise well managed. The sandy underlying layer makes the soil easy to drain, but it also makes it difficult to install tile drains and to maintain open ditches. This soil is poorly suited to trees. The high water table severely limits use of the soil for building sites or for recreational areas.

Soil management unit 1.5c (IIw); woodland suitability group W.

Lacota silty clay loam (Lc).—This nearly level soil is on outwash plains. Its surface layer is dominantly silty clay loam, but it is silt loam or clay loam in small areas.

Included with this soil are some poorly drained or very poorly drained Hettinger and Sims soils, in which the upper two layers are more than 42 inches thick or sandy material is within 18 inches of the surface. Also included are a few areas of somewhat poorly drained soils, pockets of muck in some of the areas, and some very small ridges that have slopes of more than 2 percent.

Lacota silty clay loam is well suited to crops, and all crops common to the county can be grown successfully. Yields are high if artificial drainage is provided and other good management is used. The sandy underlying layer makes the soil easy to drain, but it also makes it difficult to install tile and to maintain open ditches. This soil is poorly suited to trees. The high water table severely limits use of the soil for building sites or for recreational areas.

Soil management unit 1.5c (IIw); woodland suitability group W.

Lake Beach

Lake beach (Lk) is made up of material deposited recently along the shore of Lake Huron on low beach ridges. The areas are in a narrow strip, less than a tenth of a mile wide. The soil material is mostly coarse textured. It consists of thin layers of sand and gravel that have been deposited too recently for a soil profile to have formed. The areas closest to the water are flooded by high waves and have little or no vegetation. Marsh grasses grow in some areas (fig. 4), and a few oaks grow farther in from the shore.

This land type is not used for farming. The areas generally are not suitable for trees, but some areas have been developed for recreational purposes.

Soil management unit Sa (VIIIs); not placed in a woodland suitability group.

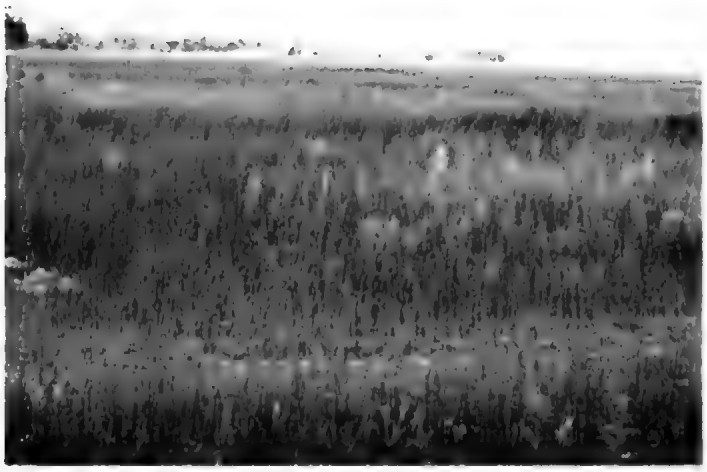

Figure 4.—**Typical of Lake beach are these marshy areas along the shore of Saginaw Bay, Lake Huron.**

Linwood Series

Linwood soils are dark colored and very poorly drained. They consist of muck or peat and are underlain by clay loam at a depth of 12 to 42 inches. The original vegetation was stands of ash, elm, white birch, white-cedar, willow, and tag alder.

Representative profile of Linwood muck in a wooded area:

0 to 7 inches, very dark brown, friable muck.
7 to 14 inches, black, firm muck; contains bits of undecomposed wood.
14 to 19 inches, very dark gray, friable muck.
19 inches +, grayish-brown, firm, limy clay loam.

The upper three layers are organic material from plant remains; the fourth layer is mineral soil material. The organic material is 12 to 42 inches thick. It consists of a variable number of black to brown layers of muck or peat. The material has granular to fibrous structure. Bits of undecomposed wood and a few buried logs are scattered throughout the organic layers. The fourth layer is sandy loam, loam, clay loam, silt loam, or silty clay loam. The organic material ranges from medium acid to neutral, and the underlying material from mildly alkaline to limy.

Permeability of these soils is moderate. Runoff is very slow to ponded.

Linwood peat and muck (Lm).—This is the only Linwood soil mapped in the county. It is in nearly level to depressional areas. Its surface layer is muck or peat but generally is a mixture of the two. The areas are wet, but those areas underlain by silty clay loam are wetter than those underlain by sandy loam.

Included with this soil are areas of Carbondale soils in which the organic material is more than 42 inches thick. Also included are some areas, near the edges of areas of this mapping unit, in which organic material is less than 12 inches thick. Other included soils are small areas of Willette, which have a clayey lower layer, and of Tawas soils, which have a sandy lower layer. A few included areas are alkaline.

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Linwood peat and muck is not used for crops. If the areas were properly drained and fertilized, yields of corn, sugarbeets, and forage would be high. It is difficult to install tile and maintain open ditches for drainage, particularly in areas underlain by sandy material. The high water table and hazards of wind erosion and frost also are problems.

This soil is poorly suited to trees. Because of the high water table and mucky nature of this soil, use of the areas for building sites or similar purposes is severely limited.

Soil management unit M/3c (IIIw); woodland suitability group J.

Mancelona Series

In the Mancelona series are light-colored, well drained to moderately well drained soils. These soils formed in deposits of sandy and gravelly outwash. The original vegetation was stands of northern hardwoods and red and white pines.

Representative profile of Mancelona loamy sand in a wooded area:

0 to 8 inches, grayish-brown, loose loamy sand.
8 to 13 inches, dark-brown, very friable loamy sand.
13 to 25 inches, brown, loose sand.
25 to 33 inches, brown, friable gravelly sandy loam.
33 inches +, yellowish-brown, loose, limy sand and gravel.

The fourth layer ranges from heavy loamy sand to gravelly sandy loam in texture. Its thickness ranges from 4 to 12 inches. Loose, limy sand and gravel are at a depth of 18 to 42 inches, though some gravel is in the upper layers in many places. The sand and gravel vary in size within a short distance, and several layers of gravel of different sizes and amounts are in most profiles. Each area must be inspected before deciding whether or not the gravel in a particular area is of commercial value. The upper part of the profile ranges from medium acid to neutral.

Permeability of these soils is moderately rapid in the upper part and rapid in the lower part. Runoff is slow.

Mancelona loamy sand, 0 to 2 percent slopes (MaA).—This nearly level soil is on terraces. It is moderately well drained. The surface layer is loamy sand in most places, but in some places it is sand. In a few areas loamy or clayey material underlies the lower layer of sand and gravel at a depth of 42 to 66 inches. Slopes are dominantly less than 2 percent but are greater in some areas. In a few cultivated fields much of the first and second layers has been removed by erosion. Here, the present plow layer is mainly material from the original subsoil and is dark brown.

Included with this soil are the somewhat poorly drained Gladwin soils in depressions and along minor natural drainageways. Also included are the sandy, well-drained Rubicon and Rousseau soils that contain little gravel and lack finer textured layers.

This Mancelona soil is droughty, low in fertility, and subject to wind erosion. It is poorly suited to most crops and is not suited to field beans or sugarbeets. Yields are moderate to low, even under good management. This soil is well suited to trees. Limitations to use of the soil for building sites, recreational areas, or similar purposes are slight.

Soil management unit 4aA (IIIs); woodland suitability group C.

Mancelona loamy sand, 2 to 6 percent slopes (MaB).—This gently sloping soil is on terraces and beach ridges. It is well drained to moderately well drained. The surface layer ranges from loamy sand to sand. Slopes are dominantly between 2 and 6 percent. In places loamy to clayey material underlies the lower layer of sand and gravel at a depth of 42 to 66 inches.

Included with this soil are the somewhat poorly drained Gladwin soils in low areas.

This Mancelona soil is poorly suited to crops because of droughtiness, low fertility, and the hazard of wind erosion. The kinds of crops that can be grown successfully are limited, and only a small acreage is cultivated. This soil is well suited to trees. Limitations to use of the soil for building sites, recreational areas, and similar purposes are slight.

Soil management unit 4aBC (IIIs); woodland suitability group C.

Manistee Series

Soils of the Manistee series are moderately dark colored and well drained to moderately well drained. These soils are sandy and are underlain by clay or silty clay at a depth of 18 to 42 inches. Stands consisting mainly of northern hardwoods, but that included a few white pines, made up the original vegetation.

Representative profile of Manistee loamy sand in a cultivated field:

0 to 8 inches, very dark grayish-brown, very friable loamy sand.
8 to 12 inches, pinkish-gray, loose sand.
12 to 24 inches, brown, very friable loamy sand.
24 to 36 inches, light-brown or light yellowish-brown, very friable sand.
36 to 42 inches +, reddish-brown, firm clay.

In areas that have never been plowed, the top layer is about 3 inches thick and is very dark gray. In these areas the second layer is about 9 inches thick. The coarse-textured upper four layers combined range from 18 to 42 inches in thickness. At a depth of about 18 inches, the third and fourth layers in some places are thinner than described. The fourth layer is absent in some areas. The change from the sandy material of the upper four layers to the clayey material below is abrupt. The fifth layer is silty clay to clay in texture and is nearly red to reddish brown in color. The sandy part of the profile is slightly acid to strongly acid. The clay layer ranges from slightly acid in the upper part to limy with increasing depth.

Permeability is rapid in the sandy part of the profile and very slow in the clay. Runoff is slow.

Manistee loamy sand, 0 to 2 percent slopes (MdA).—This nearly level soil is on the tops of small ridges and hills. It is moderately well drained.

Included with this soil are small areas of the somewhat poorly drained Allendale soils. Also included are small areas of Kent soils, in which the depth of sandy material is less than 18 inches, and of Rubicon soils, in which it is more than 42 inches. Other included small areas have slopes of more than 2 percent.

This Manistee soil is somewhat droughty and is subject to wind erosion in places. It is moderately well suited to crops. The kinds of crops that can be grown are limited, and yields are moderate to low. This soil is well suited to trees. Shallowness to clay moderately limits use of this soil for building sites, recreational areas, or similar purposes.

Soil management unit 4/2aA (IIIs); woodland suitability group A.

Manistee loamy sand, 2 to 6 percent slopes (MdB).—This gently sloping soil is on ridges and hillsides. In a few freshly plowed fields, brown material from the subsoil is exposed because of erosion.

Included with this soil are small areas of Kent soils, in which the depth of sandy material is less than 18 inches, and of Rubicon soils, in which it is more than 42 inches.

This Manistee soil is somewhat droughty and is subject to wind and water erosion. It is moderately well suited to many crops, but field beans and sugarbeets are poorly suited. Yields are moderate to low. This soil is well suited to trees. Shallowness to clay moderately limits use of this soil for building sites, recreational areas, or similar purposes.

Soil management unit 4/2aB (IIIs); woodland suitability group A.

Markey Series

Soils of the Markey series are dark colored and very poorly drained. These soils consist of muck and peat. They are underlain by mildly alkaline to limy, sandy material at a depth of 12 to 42 inches. The original vegetation was stands of lowland hardwoods, white-cedar, and black spruce.

Representative profile of Markey muck:

0 to 14 inches, black, friable muck; well granulated and contains pieces of wood.
14 to 30 inches, yellowish-brown peat, in which individual plant remains can be distinguished.
30 to 42 inches +, light brownish-gray, loose, limy sand.

The upper two layers consist of plant remains and have a total thickness of 12 to 42 inches. They are muck or peat, or a mixture of the two. The third layer is mineral material and contains little organic matter. It is sand or loamy sand. The upper two layers are mildly alkaline to moderately alkaline.

Permeability of these soils is moderately rapid. Runoff is very slow to ponded.

Markey muck (Me).—This is the only Markey soil mapped in the county. It is in depressions and along small natural drainageways. A small part of the area is covered with sandy material, and a few areas are limy at the surface. The surface layer is predominantly muck, but it is mucky peat in a few areas. Slopes are less than 2 percent.

Included with this soil are a few small areas in which depth of the organic layers is either more than 42 inches or is less than 12 inches.

Only a small acreage of Markey muck has been cleared. This soil is poorly suited to crops and trees. The high water table and mucky surface layer severely limit use of this soil for building sites, recreational areas, or similar purposes.

Soil management unit M/4c (IVw); woodland suitability group J.

Maumee Series

Soils of the Maumee series are very dark colored and very poorly drained. These soils consist of mucky and sandy material. The original vegetation was stands of willow, tag alder, and marsh grass.

Representative profile of Maumee mucky loamy sand in a cultivated field:

0 to 18 inches, black, very friable mucky loamy sand.
18 to 28 inches, pale-brown, very friable loamy sand.
28 to 34 inches, light yellowish-brown, loose sand.
34 to 44 inches +, light brownish-gray, loose, limy sand.

In some areas a layer of muck 5 to 12 inches thick is on the surface. In other areas mineral layers that are finer textured than described are at a depth below 42 inches. The texture of the surface layer ranges from mucky loamy sand to mucky sandy loam. The layers of sand and loamy sand contain thin layers of silt, very fine sand, or silt loam in places. In a few places gravel is in the third and fourth layers. Yellow and brown mottlings are present in places in the fourth layer. The surface layer is generally neutral to moderately alkaline. In places, however, the soil is limy at a depth of 0 to 30 inches.

Permeability of these soils is very rapid. Runoff is very slow to ponded. Slopes are 2 percent or less.

The Maumee soils are mostly in native swamps. Only a small acreage has been cleared and drained and is used for crops.

Maumee mucky loamy sand (Mk).—This nearly level soil is very poorly drained. The surface soil is mucky and black. Its thickness ranges from less than 10 to more than 24 inches within a very short distance. In a few places the soil is underlain by finer textured material within 42 inches of the surface. In small areas the surface layer is mucky sand.

Included with this soil are a few areas of Markey and Tawas soils that have a surface layer of muck more than 12 inches thick.

This Maumee soil is naturally wet and needs artificial drainage; it is also subject to wind erosion. Much of the acreage is used for crops, to which this soil is moderately well suited. All of the common crops, except field beans, can be grown, and yields are moderate to moderately high. This soil is poorly suited to trees. The high water table severely limits use of this soil for building sites or recreational developments.

Soil management unit 5c (IVw); woodland suitability group Q.

Maumee mucky sandy loam (Mm).—This nearly level soil is in areas where natural drainage is restricted. The texture of the surface layer is generally mucky sandy loam, but in a few places it is mucky loamy sand, mucky sand, or loam.

Included with this soil are areas of Markey and Tawas soils that have a surface layer of muck more than 12 inches thick.

This Maumee soil is wet and is subject to wind erosion. It is moderately well suited to crops, and some areas have been cleared and are used for crops. All of the common

crops can be grown, and yields are moderate to high. This soil is poorly suited to trees. The high water table severely limits use of this soil for building sites or recreational developments.

Soil management unit 5c (IVw); woodland suitability group Q.

Maumee association (Mn).—This mapping unit is on low, sandy outwash plains in closed depressions. The areas vary in size. Slopes are 1 percent or less. The surface layer is thick, dark, mucky sand 1 to 2 feet thick. Below is gray sand. In undrained areas the water table is at or near the surface for much of the year. In a few areas peat is on the surface.

Included with this mapping unit are areas of Tawas soils that have a surface layer of muck more than 12 inches thick. Also included are some Roscommon soils that have a thin, mucky surface layer or lack such a layer.

Most areas of this Maumee unit are idle; little of the acreage has been cleared or drained. The largest area is a swamp in Adams Township, west of Sterling. Smaller areas are scattered through the western part of the county. All of the areas have a cover of willow and tag alder near the edges and reeds and grasses toward the center.

Soil management unit 5c (IVw); woodland suitability group Q.

Menominee Series

In the Menominee series are light-colored and well drained to moderately well drained soils. These soils are sandy and are underlain by heavy loam to silty clay loam at a depth of 18 to 42 inches. They are in the uplands on sand-covered moraines and till plains. The original vegetation was stands of northern hardwoods and white pines.

Representative profile of Menominee loamy sand in a cultivated field:

0 to 8 inches, very dark grayish brown, very friable loamy sand.
8 to 11 inches, pinkish-gray, loose sand.
11 to 32 inches, dark yellowish-brown to dark-brown, loose sand.
32 to 40 inches, pale-brown, loose sand.
40 inches +, reddish-brown, firm, limy clay loam.

In areas that have not been plowed, the surface layer is 2 to 3 inches thick and is very dark gray in color. In these places the second layer is about 9 inches thick. The first four layers combined range from 18 to 42 inches in thickness. In some places, the third layer is thinner than described and the fourth is lacking. The texture of the first four layers ranges from sand to loamy sand. The sandy part of the profile is strongly acid to slightly acid. The change from sandy material in the first four layers to the firm, clayey material is abrupt. The fifth layer is loam, sandy clay loam, clay loam, or silty clay loam. It is generally limy, but in places the upper few inches are free of lime. Slopes are mainly 0 to 12 percent but in a few places are as much as 45 percent.

Permeability of the upper part of the profile is rapid, and that of the lower part is moderately slow. Runoff is slow on the mild slopes and moderate on the steep.

Menominee loamy sand, 0 to 2 percent slopes (MoA).—This nearly level soil is on hilltops adjacent to natural drainageways. It is moderately well drained. The surface layer is dominantly loamy sand but is sand or fine sand in small areas. Slopes are dominantly 2 percent or less but are steeper in a few small areas. A few spots have been eroded by wind, and here plowing has exposed the dark yellowish-brown layer.

Included with this soil are small areas of the somewhat poorly drained Iosco soils in depressions and along small natural drainageways. Also included are small areas of Nester or Isabella loamy sand, in which sandy material is less than 18 inches thick, and of Rubicon loamy sand, in which it is more than 42 inches.

Most areas of this Menominee soil are in crops common to the area. This soil is somewhat droughty, moderately fertile, and subject to wind erosion. It is moderately well suited to corn, oats, and wheat, is poorly suited to field beans, and is not suited to sugarbeets. It is well suited to trees. Limitations to use of this soil for building sites or for intensive recreational development are slight.

Soil management unit 4/2aA (IIIs); woodland suitability group A.

Menominee loamy sand, 2 to 6 percent slopes (MoB).—This gently sloping soil is on hillsides and low ridges. It is well drained to moderately well drained. The surface layer is dominantly loamy sand but is sand or fine sand in small areas. A few areas have been eroded by wind and water. In these areas the dark yellowish-brown subsoil is exposed in plowed fields. Slopes are dominantly between 2 and 6 percent, but they are outside these limits in small areas.

Included with this soil are the somewhat poorly drained Iosco soils in shallow, closed depressions and in natural drainageways. Also included are areas of Nester or Isabella loamy sand, in which sandy material is less than 18 inches thick, and of Rubicon loamy sand, in which it is more than 42 inches thick.

Most areas of this Menominee soil are in crops and pasture. This soil is droughty and is subject to wind and water erosion. It is moderately well suited to small grains, is poorly suited to field beans, and is not suited to sugarbeets. It is well suited to trees. Limitations to use of the soil for building sites or for intensive recreational development are slight.

Soil management unit 4/2aB (IIIs); woodland suitability group A.

Menominee loamy sand, 6 to 12 percent slopes (MoC).—This moderately sloping soil is on hillsides. It is well drained. The surface layer is dominantly loamy sand but is sand or fine sand in small areas. Slopes are dominantly between 6 and 12 percent but are outside these limits in small areas. A few areas have been eroded, and here dark yellowish-brown material from the subsoil is exposed in plowed fields. In some eroded areas the original sandy material was quite thin, and the present surface layer in these places is loam to silty clay loam.

Included with this soil are areas of Nester or Isabella soils, in which sandy material is less than 18 inches thick, and of Rubicon soils, in which it is more than 42 inches thick.

Most of this Menominee soil is used for crops. It is droughty and highly susceptible to wind and water erosion. It is poorly suited to corn, oats, and wheat, is not suited to field beans or sugarbeets, but is well suited to trees. Limitations to use of this soil for building sites or for intensive recreational development are moderate.

Soil management unit 4/2aC (IIIe); woodland suitability group A.

Menominee loamy sand, 12 to 18 percent slopes (MoD).—This strongly sloping soil has good natural drainage. Its surface layer is loamy sand or sand.

Only a small acreage of this soil is in crops. The soil is droughty and is highly susceptible to wind and water erosion. It is not suited to corn, field beans, and sugarbeets, is poorly suited to oats and wheat, but is well suited to trees. Limitations to use of the areas for building sites or for intensive recreational development are moderate.

Soil management unit 4/2aD (IVe); woodland suitability group A.

Menominee loamy sand, 18 to 25 percent slopes (MoE).—This steeply sloping soil is on hillsides and is well drained. The surface layer is dominantly loamy sand but is sand in a few small areas. Slopes are dominantly between 18 and 25 percent but are outside these limits in small areas. In places some of the sandy material has been removed through erosion, and in such places the sandy material in many places is less than 18 inches thick. The material below the sand ranges from loam to clay loam in texture.

This soil is highly susceptible to erosion. It is not suited to small grains, field beans, and sugarbeets but is well suited to trees. Limitations to use of the areas for building sites and for intensive recreational development are severe.

Soil management unit 4/2aD (IVe); woodland suitability group A.

Menominee loamy sand, 25 to 45 percent slopes, moderately eroded (MoF2).—This steep soil is well drained. The surface layer is loamy sand in most areas but is sand in a few places. The sandy material ranges from about 0 to more than 42 inches in thickness.

The steep slopes and high susceptibility to erosion make this soil unsuitable for crops. This soil is well suited to trees. Use of the areas for building sites or for intensive recreational development is severely limited.

Soil management unit 4/2aD (IVe); woodland suitability group A.

Menominee sand, 0 to 2 percent slopes (MsA).—This nearly level soil is on hilltops adjacent to natural drainageways. It is moderately well drained. The surface layer is sand in most places but is fine sand or loamy sand in small areas. Slopes are dominantly 2 percent or less but are greater in a few small areas. In cultivated fields much of the original surface soil has been removed through erosion, and in small areas plowing has mixed yellowish-brown material from the subsoil with the remaining surface soil to form the present plow layer.

Included with this soil are small areas of poorly drained Iosco soils in closed depressions and narrow natural drainageways. Also included are small areas of Rubicon soils in which the sand is more than 42 inches thick.

More than half the acreage of this Menominee soil is in crops, and wind erosion is a hazard in these areas. The remaining acreage is in pasture and woodland. This soil is droughty and is highly susceptible to wind erosion. Field beans and sugarbeets are not suited, and yields of corn, oats, and wheat are low to moderately low. This soil is well suited to trees. Limitations to use of the areas for building sites or recreational developments are slight.

Soil management unit 4/2aA (IIIs); woodland suitability group A.

Menominee sand, 2 to 6 percent slopes (MsB).—This gently sloping soil is on hillsides and low ridges. It is well drained to moderately well drained. The surface layer is dominantly sand but is loamy sand or fine sand in small areas. Slopes are dominantly between 2 and 6 percent but are outside these limits in small areas. A few areas have been eroded by wind or water. In these areas a small amount of yellowish-brown material from the subsoil has been mixed with the remaining surface layer to form the present plow layer.

Included with this soil are the somewhat poorly drained Iosco soils in a few shallow depressions and narrow natural drainageways. Also included are small areas of Rubicon soils in which the sand is more than 42 inches thick.

Most areas of this Menominee soil are used for crops. This soil is droughty and is highly susceptible to wind erosion. It is not suited to field beans or sugarbeets, and yields of corn, oats, and wheat are low to moderately low. This soil is well suited to trees. Limitations to use of the soil for building sites or recreational areas are slight.

Soil management unit 4/2aB (IIIs); woodland suitability group A.

Menominee sand, 6 to 12 percent slopes (MsC).—This moderately sloping soil is on hillsides. It is well drained. The surface layer is dominantly sand but is loamy sand or fine sand in small areas. Slopes are dominantly between 6 and 12 percent but are outside these limits in small areas. A few areas have been eroded, and here some yellowish-brown material from the subsoil is in the plow layer.

Included with this soil are areas of the Nester and Isabella soils, in which the sandy material is less than 18 inches thick and of the Rubicon soils, in which the sand is more than 42 inches thick.

Most areas of this Menominee soil are used for crops, though this soil is poorly suited to crops. Field beans or sugarbeets are not suited, and yields of grain crops are low. This soil is well suited to trees. Use of the areas for building sites or for intensive recreational development is somewhat limited.

Soil management unit 4/2aC (IIIe); woodland suitability group A.

Nester Series

Soils of the Nester series are moderately dark colored and are well drained and moderately well drained. These soils formed in loamy glacial till. The original vegetation was stands of northern hardwoods, hemlocks, and white pines.

Representative profile of Nester fine sandy loam in a pasture:

0 to 4 inches, very dark gray, friable fine sandy loam.
4 to 8 inches, pale-brown, friable fine sandy loam.
8 to 28 inches, pale-brown to reddish-brown, firm clay loam that breaks to small, well-defined blocks.
28 to 42 inches +, brown, firm, limy clay loam.

The surface layer is fine sandy loam, loam, silty clay loam, or clay loam; the sandy loams are less than 18 inches thick over clay loam. In plowed fields the first and second layers are mixed together to form a dark grayish-brown plow layer. The second layer is nearly

white when dry. The third layer is clay loam, silty clay loam, or light clay and has well-defined, blocky structure. The fourth layer contains a few mottles in places where drainage is moderately good; this layer also has streaks of lime in many places. The soils are neutral to slightly acid to a depth of 20 to 40 inches and limy below. Slopes range from 0 to 55 percent but are dominantly 2 to 12 percent. Shown in figure 5 are Nester soils, which are excellent for corn, oats, and wheat but are subject to water erosion.

Permeability of the Nester soils is moderately slow. Runoff is medium on the milder slopes and rapid on the steeper ones.

Nester clay loam, 6 to 12 percent slopes, severely eroded (NcC3).—This soil is moderately sloping and is well drained or moderately well drained. Most of the original surface layer of sandy loam or loam has been removed through erosion. The present surface layer consists mainly of reddish-brown clay loam from the original third layer. In small uneroded areas the surface layer is loam or sandy loam. In a few places there are small gullies that can be crossed with machinery. Small, wet, seep spots are on some hillsides. Slopes are dominantly between 6 and 12 percent but are outside these limits in small areas.

Most areas of this soil are in crops or were formerly used for crops. Because of erosion this soil is not now suited to crops other than hay crops. It is poorly suited to trees. Use of this soil for building sites or for recreational areas is severely limited.

Soil management unit 1.5aCD3 (VIe); woodland suitability group B.

Nester clay loam, 12 to 18 percent slopes, severely eroded (NcD3).—This soil is strongly sloping and is well drained. Most of the original surface layer of sandy loam or loam has been removed through erosion. The present surface layer is mainly reddish-brown clay loam from the original third layer. In small uneroded areas the surface layer is loam or sandy loam. In a few areas there are small gullies that are crossable with machinery. Small, seep spots are on some hillsides. Slopes are dominantly between 12 and 18 percent but are outside these limits in small areas.

Most areas of this soil are in pasture, but part of the acreage was formerly in crops. This soil is not suited to crops other than hay crops. It is poorly suited to trees. Use of this soil for building sites or for recreational areas is severely limited.

Soil management unit 1.5aCD3 (VIe); woodland suitability group B.

Nester clay loam, 18 to 25 percent slopes, severely eroded (NcE3).—This hilly soil is well drained. All of the original surface layer has been removed through erosion. The present surface layer is mainly reddish-brown clay loam from the original third layer. In a few small protected areas, the surface layer is sandy loam or loam. In a few places there are small gullies, and in these the soil material is eroded to the depth of the limy clay loam. Slopes are dominantly between 18 and 25 percent but are outside these limits in small areas. A few seep spots are on the hillsides.

Figure 5.—**Typical view of Nester soils in capability classes II and III.**

Most of this soil is in pasture or is woodland. This soil is not suited to crops and is poorly suited to trees. Use of this soil for building sites or for recreational areas is severely limited.

Soil management unit 1.5aEF3 (VIIe); woodland suitability group B.

Nester clay loam, 25 to 55 percent slopes, severely eroded (NcF3).—This steep soil is well drained. Much of the original surface layer has been removed through erosion. The present surface layer is mainly reddish-brown clay loam from the original third layer. In a few small gullies, the soil is eroded to the depth of the limy material. Slopes are dominantly more than 25 percent but are less in very small areas. A few wet seep spots are on the sides of the hills.

Most areas of this soil are in pasture or are wooded. This soil is not suited to crops and is poorly suited to planting of trees. Use of this soil for building sites or for recreational areas is severely limited.

Soil management unit 1.5aEF3 (VIIe); woodland suitability group B.

Nester fine sandy loam, 0 to 2 percent slopes (NfA).—This nearly level soil is on hilltops and is moderately well drained. The surface layer is dominantly fine sandy loam but is sandy loam in fairly large areas and loamy sand and loam in small areas. Where the surface layer is more than 18 inches thick, and in some areas where it is less than 18 inches thick, there is a thin layer of brown sandy loam immediately below it. In a few areas plowing is as deep as the third layer, and in places clay loam from this layer is brought to the surface by plowing. In small areas slopes are more than 2 percent.

Included with this soil are the somewhat poorly drained Kawkawlin soils in shallow depressions and along small natural drainageways.

This Nester soil is moderately well suited to crops. Yields are moderately high to high. This soil is well suited to trees. The permeability and texture somewhat limit use of this soil for building sites or for intensive recreational development.

Soil management unit 1.5aA (IIs); woodland suitability group B.

Nester fine sandy loam, 2 to 6 percent slopes (NfB).—This gently sloping soil is in the uplands. It is well drained to moderately well drained. The surface layer is dominantly fine sandy loam, but it is sandy loam in fairly large areas and loam and loamy sand in small areas. Where the surface layer is more than 18 inches thick, and in some areas where it is less than 18 inches thick, there is a thin layer of brown sandy loam immediately below it. In some areas plowing is as deep as the third layer and in places has brought clay loam from this layer to the surface. Slopes are dominantly between 2 and 6 percent but are outside these limits in small areas.

Included with this soil are the somewhat poorly drained Kawkawlin soils in depressions and along natural drainageways.

Most areas of this Nester soil are in crops or in improved pasture. This soil is moderately well suited to crops, and yields are moderately high to high for the crops commonly grown. In places water erosion is a hazard. This soil is well suited to trees. The permeability and texture somewhat limit use of this soil for building sites or for intensive recreational development.

Soil management unit 1.5aB (IIe); woodland suitability group B.

Nester fine sandy loam, 2 to 6 percent slopes, moderately eroded (NfB2).—This gently sloping soil is well drained to moderately well drained. Much of the surface layer has been removed through erosion. The present plow layer, in 40 to 80 percent of the areas, consists mainly of reddish-brown clay loam from the original third layer. In the less eroded areas, the surface layer is dominantly fine sandy loam, but in small areas it is sandy loam or loamy sand. In the more eroded areas, the surface layer is dominantly loam and clay loam. In small areas the soil is slightly eroded or severely eroded. In the severely eroded areas, the plow layer is dominantly clay loam. Slopes are dominantly between 2 and 6 percent but are outside these limits in small areas.

Most areas of this soil are in crops or have been in crops. This soil is moderately well suited to most crops. Yields are moderately high for grain and hay but moderate for field beans. This soil is not suited to sugarbeets. In places water erosion is a hazard. This soil is well suited to trees. The permeability and texture somewhat limit use of the areas for building sites or for intensive recreational development.

Soil management unit 1.5aB2 (IIIe); woodland suitability group B.

Nester fine sandy loam, 6 to 12 percent slopes (NfC).—This moderately sloping soil is on the sides of hills. It is well drained. The surface layer is dominantly fine sandy loam but is sandy loam in fairly large areas and loamy sand or loam in small areas. Where the surface layer is more than 18 inches thick, and in some areas where it is less than 18 inches thick, there is a thin layer of brown sandy loam immediately below it. In cultivated fields plowing is as deep as the third layer and in places has brought clay loam from this layer to the surface. In eroded areas the surface layer is loam or clay loam. Slopes are dominantly between 6 and 12 percent but are outside these limits in small areas.

Included with this soil are the somewhat poorly drained Kawkawlin soils around seep spots on the sides of hills.

Most areas of this Nester soil are in crops, but small areas are in pasture or trees. This soil is highly susceptible to water erosion. It is moderately well suited to most crops. Yields of most crops are moderately high, but yields of hay are high. Sugarbeets are not suited. This soil is well suited to trees. Use of this soil for building sites or for intensive recreational development is moderately limited because of the permeability, texture, and slope.

Soil management unit 1.5aC (IIIe); woodland suitability group B.

Nester fine sandy loam, 6 to 12 percent slopes, moderately eroded (NfC2).—This moderately sloping soil is well drained. Much of the original surface layer has been removed through erosion. The present plow layer, in 40 to 80 percent of the areas, consists mainly of reddish-brown clay loam from the original third layer. The surface layer is dominantly fine sandy loam in the less eroded areas but is sandy loam or loam in some small areas. In the more eroded areas, the surface layer is dominantly loam and clay loam. In small areas the soil is slightly eroded and severely eroded. In the severely eroded areas, the plow layer is more than 80 percent clay

loam. Slopes are dominantly between 6 and 12 percent but are outside these limits in small areas.

Most areas of this Nester soil are now used for crops or have been cropped. This soil is moderately well suited to crops, but the kinds of crops that can be grown are limited. It is not suited to field beans or sugarbeets. Yields of corn, oats, and wheat are moderate, and yields of hay are high. This soil is highly susceptible to water erosion. Use of this soil for building sites or for intensive recreational development is moderately limited because of slope, permeability, and texture.

Soil management unit 1.5aC2 (IIIe); woodland suitability group B.

Nester fine sandy loam, 12 to 18 percent slopes (NfD).—This strongly sloping soil is on the sides of hills. It is well drained. The surface layer is dominantly fine sandy loam but is sandy loam in fairly large areas and loamy sand or loam in small areas. Where the surface layer is more than 18 inches thick, and in some areas where it is less than 18 inches thick, there is a thin layer of brown sandy loam immediately below it. In cultivated fields plowing is as deep as the third layer and in places has brought clay loam from this layer to the surface. In severely eroded areas the surface layer is loam or clay loam. Slopes are dominantly between 12 and 18 percent but are outside these limits in small areas.

Included with this soil are the somewhat poorly drained Kawkawlin soils around seep spots on the sides of hills.

Most of this Nester soil is in pasture, but small areas are in crops or in trees. This soil is not well suited to corn, field beans, or sugarbeets. Yields of oats and wheat are moderate, and yields of hay are high. The hazard of erosion is severe. This soil is well suited to trees. The slope, permeability, and texture severely limit use of this soil for building sites or for intensive recreational development.

Soil management unit 1.5aD (IVe); woodland suitability group B.

Nester fine sandy loam, 12 to 18 percent slopes, moderately eroded (NfD2).—This strongly sloping soil is on the sides of hills. It is well drained. Much of the original surface layer has been removed through erosion. The present surface layer, in 40 to 80 percent of the acreage, is largely clay loam. In areas that are not much eroded, the surface layer is fine sandy loam and sandy loam. In the more eroded areas, the surface layer is loam or clay loam. A few seep spots are on the sides of some hills. Some areas have lost all of the original first and second layers through erosion and have a few small gullies in places.

Most areas of this soil are now in pasture or wooded, though most areas were cultivated at some time. This soil is poorly suited to corn, field beans, and sugarbeets. Yields of oats and wheat are low to moderate, but yields of hay are high. The hazard of erosion is severe. Care is therefore needed to prevent further erosion and to reduce present erosion. This soil is well suited to trees. The steep slope, permeability, texture, and erosion severely limit use of this soil for building sites or for intensive recreational development.

Soil management unit 1.5aD (IVe); woodland suitability group B.

Nester fine sandy loam, 18 to 25 percent slopes (NfE).—This hilly soil is well drained. The surface layer is dominantly fine sandy loam, but it is sandy loam in fairly large areas and loam, clay loam, and loamy sand in small areas. A few areas are eroded, and here the layers of sandy loam are very thin or are lacking. Slopes are dominantly between 18 and 25 percent but are outside these limits in small areas. A few seep spots are on the sides of some hills.

Most areas of this soil are in pasture or wooded and are therefore not eroded. This soil is not suited to crops but is well suited to hay. The hazard of erosion is severe. This soil is well suited to trees. The slope, permeability, and texture severely limit use of this soil for building sites or for intensive recreational development.

Soil management unit 1.5aE (VIe); woodland suitability group B.

Nester fine sandy loam, 18 to 25 percent slopes, moderately eroded (NfE2).—This hilly soil is well drained. Much of the original surface layer has been removed through erosion. The present surface layer, in 40 to 80 percent of the areas, is mainly clay loam. Some areas are not much eroded, and in these areas the surface layer is predominantly fine sandy loam and sandy loam. A few seep spots are on the sides of some hills. Some areas have lost all of the original first and second layers through erosion and have a few small gullies in places.

Most of this soil is in pasture or is wooded. This soil is not suited to any crops other than hay crops. If it is not protected by close-growing plants, the hazard of erosion is severe. This soil is well suited to trees. The slope, permeability, texture, and erosion severely limit use of this soil for building sites or for intensive recreational development.

Soil management unit 1.5aE (VIe); woodland suitability group B.

Nester fine sandy loam, 25 to 55 percent slopes (NfF).—This steep soil is well drained. The surface layer is dominantly fine sandy loam, but it is sandy loam in fairly large areas and loam, clay loam, and loamy sand in small areas. A few areas are eroded, and here layers of sandy loam are very thin or are absent. Slopes are dominantly more than 25 percent but are less in a few small areas. A few seep spots are on the sides of some hills.

Most of this soil is in pasture or woodland and has therefore been protected from severe erosion. This soil is not suited to crops, because of the very steep slopes. It is well suited to trees. The slope, permeability, and texture severely limit use of this soil for building sites or for intensive recreational development.

Soil management unit 1.5aF (VIIe); woodland suitability group B.

Nester fine sandy loam, 25 to 55 percent slopes, moderately eroded (NfF2).—This steep soil is well drained. Much of the original surface layer has been removed through erosion. The present surface layer, in 40 to 80 percent of the areas, is mainly clay loam. Some areas are not much eroded, and here the surface layer is fine sandy loam and sandy loam. In the more eroded areas, the surface layer is loam or clay loam. A few seep spots are on the sides of some hills. In some areas the original first and second layers have been removed through erosion and there are a few small gullies.

Most of this soil is in pasture or trees. This soil is not suited to crops, because of steep slopes and erosion. It is well suited to trees. The slope, permeability, and

texture severely limit use of this soil for building sites or for intensive recreational development.

Soil management unit 1.5aF (VIIe); woodland suitability group B.

Nester loam, 2 to 6 percent slopes (NmB).—This gently sloping soil is on lake plains. It is moderately well drained. In some wooded areas a thin layer of sandy material is on the surface. The surface layer is dominantly loam but is silt loam or sandy loam in small areas. In places the soil consists of stratified silty clay loam, clay loam, silt, and sand. Slopes are dominantly between 2 and 6 percent but are outside these limits in small areas. Included with this soil are somewhat poorly drained Bowers soils in shallow depressions and along minor natural drainageways.

Most areas of this Nester soil are in crops. This soil is well suited to all of the crops commonly grown, except sugarbeets. Erosion is a hazard in some places. This soil is also well suited to trees. The permeability and texture somewhat limit use of this soil for building sites or for intensive recreational development.

Soil management unit 1.5aB (IIe); woodland suitability group B.

Nester silty clay loam, 2 to 6 percent slopes (NoB).—This gently sloping, moderately well drained soil is on lake plains. In some wooded areas a thin layer of sandy material is on the surface. The surface layer is dominantly silty clay loam but is clay loam or silt loam in small areas. The lower layers in this soil are dominantly stratified silty clay loam, clay loam, and silt but include some fine sand. Slopes are dominantly between 2 and 6 percent, but they are outside these limits in small areas.

Included with this soil are somewhat poorly drained Bowers soils in shallow depressions and along minor natural drainageways.

Most areas of this Nester soil are in crops, to which this soil is well suited. Yields are moderately high to high. Erosion is a hazard in some places. This soil is also well suited to trees. The permeability and texture somewhat limit use of this soil for building sites and for intensive recreational development.

Soil management unit 1.5aB (IIe); woodland suitability group B.

Nester-Iosco-Rubicon association, steep (NrE).—This mapping unit is on steep slopes that adjoin the Rifle River and some of its larger tributaries. Slopes range from 18 to more than 25 percent. The river valley is in a sand-covered till plain, and the amount of sand on the steep slopes varies.

The Nester soils have a very thin layer of sand over glacial till or are glacial till to the surface. The Rubicon soils consist of 42 to 66 inches of sand over glacial till. Both are well drained to moderately well drained. Iosco soils are somewhat poorly drained. They consist of sandy material that is 18 to 42 inches thick over glacial till. Smaller areas of the Menominee and Kawkawlin soils are included.

Most areas of this mapping unit are wooded. On the sides of some of the steep hills, there are a few small gullies. This mapping unit is not suited to crops, and its suitability for trees varies. The Nester and Menominee soils are well suited to trees, but the other soils are poorly suited. Because the soils are variable, an investigation at the site is needed before using an area for building sites or for intensive recreational development.

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Soil management unit 1.5aF (VIIe); woodland suitability group B.

Pickford Series

Soils of the Pickford series are dark colored and clayey. They are poorly drained. The original vegetation was stands of mixed hardwoods and conifers that included soft maple, elm, hemlock, white-cedar, and spruce.

Representative profile of Pickford silty clay loam in a plowed field:

0 to 6 inches, black, firm silty clay loam; granular structure.
6 to 30 inches, grayish-brown to light brownish-gray clay; very firm when moist, very sticky when wet; distinct, brown mottles.
30 to 42 inches +, light brownish-gray, limy clay; very firm when moist, very sticky when wet; brown mottles.

In some plowed fields the surface layer is thicker than the depth of plowing. The surface layer ranges from loamy sand to silty clay in texture, and the sandy material is less than 18 inches thick. The second and third layers are clay or silty clay, but the third layer is limy and the second lacks lime. The boundary between the second and third layers is at a depth of 15 to 30 inches. Mottling ranges from very weak to prominent. Slopes are less than 2 percent.

Permeability of these soils is slow. Runoff is very slow to ponded.

The Pickford soils are moderately extensive in the county. Poor drainage is a problem, but if adequate drainage is provided, these soils are productive. Large areas have been drained and are in crops; undrained areas are in pasture or are wooded.

Pickford fine sandy loam (Pc).—This soil is underlain by clay or silty clay at a depth of 8 to 15 inches in most places. In small areas, however, the soil is fine sandy loam to a depth of 18 inches or more. In some small areas the surface soil is sandy loam or loam. A few areas are limy at or near the surface.

Included with this soil are small areas of the very poorly drained Bergland soils along very shallow natural drainageways.

The larger areas of this Pickford soil are artificially drained and used for crops. Many of the smaller depressions are used for pasture or woodland. This soil is moderately well suited to crops, and yields are moderately high. Wetness is a problem, and drainage is needed. Because of the fine texture of this soil, tillage must be done with care. This soil is poorly suited to trees. The permeability, texture, and high water table severely limit use of this soil for building sites or for intensive recreational development.

Soil management unit 1c (IIIw); woodland suitability group P.

Pickford loamy sand (Pd).—This soil is less than 18 inches thick over clay or silty clay. A few areas are limy at the surface. Slopes are more than 2 percent in a few places.

Included with this soil are small areas of Pinconning loamy sand that is more than 18 inches thick.

This Pickford soil is moderately well suited to crops. Yields are moderate to moderately high. Artificial drainage is needed and wind erosion must be controlled

before crops can be grown successfully. This soil is poorly suited to trees. The permeability, texture, and high water table severely limit use of this soil for building sites or for intensive recreational development.

Soil management unit 1c (IIIw); woodland suitability group P.

Pickford silty clay (Pk).—The surface layer of this soil is silty clay or clay. It is generally cloddy when dry and cracks readily. In small areas the surface layer is silty clay loam.

Included with this soil are the very poorly drained Bergland soils in slight depressions and along minor natural drainageways. Slopes to some of these drainageways are more than 2 percent in a few areas. Also included are small areas of the Charity soils, which are limy at or near the surface.

Much of the acreage of this Pickford soil has been drained and is used for crops. The smaller, undrained areas are wooded or in pasture. This soil is moderately well suited to crops. Yields are moderately high. Wetness is a problem, and drainage is needed. Because of the fine texture of this soil, tillage must be done with care. This soil is poorly suited to trees. The permeability, texture, and high water table severely limit use of this soil for building sites or for intensive recreational development.

Soil management unit 1c (IIIw); woodland suitability group P.

Pickford silty clay loam (Pm).—This soil is underlain by clay or silty clay at a depth of 8 to 18 inches. In fairly large areas the surface layer is clay loam, but in small areas it is silt loam and silty clay. A profile of Pickford silty clay loam is shown in figure 6.

Included with this soil are the very poorly drained Bergland soils in shallow depressions and along minor natural drainageways. The side slopes of these drainageways are more than 2 percent in a few areas. Also included are a few areas of the Charity soils, which are limy at or near the surface.

Most large, level areas of this soil have been artificially drained and are used for crops. Some of the smaller areas in depressions are not drained and are in woodland or pasture. This soil is moderately well suited to crops. Yields are moderately high. Wetness is a problem, and drainage is needed. Because of the fine texture of this soil, tillage must be done with care. This soil is poorly suited to trees. The permeability, texture, and high water table severely limit use of this soil for building sites or for intensive recreational development.

Soil management unit 1c (IIIw); woodland suitability group P.

Pinconning Series

Soils of the Pinconning series are dark colored and poorly drained to very poorly drained. They are sandy and are underlain by clay at a depth of 18 to 42 inches. The original vegetation was stands of lowland hardwoods and conifers.

Representative profile of Pinconning loamy sand in a plowed field:

0 to 7 inches, very dark gray, very friable loamy sand.
7 to 12 inches, grayish-brown, very friable loamy sand.
12 to 30 inches, very pale brown, loose loamy sand.
30 to 42 inches +, reddish-brown, very firm, limy clay.

Figure 6.—**Profile of Pickford silty clay loam, showing strong, angular blocky structure in the upper part and coarse, strong, blocky structure at a depth of 20 inches or more; below a depth of about 20 inches, the structure has been broken by a spade. (The length of the measure is 30 inches.)**

A layer of muck 2 to 6 inches thick is on the surface of some uncultivated areas. In some places the original black surface layer extends below the depth of plowing. The upper, sandy part of the profile is 18 to 42 inches thick and ranges from loamy sand to sand in texture. The lower, clayey part of the profile is silty clay or clay. In a few places bright-colored mottlings are in the sandy layers and faint mottling is common in the clay. The sandy part of the profile is slightly acid to neutral, but the clay is limy. In a few places a few inches of sand just above the clay are also limy. Slopes are less than 2 percent.

Permeability of the sandy part of the profile is rapid, but that of the clay is slow. Runoff is very slow to ponded.

Pinconning loamy sand (Ps).—This is the only Pinconning soil mapped in the county. It is nearly level and is in low areas. The water table is commonly within a few feet of the surface in undrained areas. Small areas are limy at the surface.

Included with this soil are areas of Pickford soils, in which the sandy material is less than 18 inches thick, and of Roscommon soils, in which it is more than 42 inches

thick. Also included are small areas of the somewhat poorly drained Allendale soils.

Most areas of this Pinconning soil remain in native swamp trees. This soil is moderately well suited to crops. Yields are quite variable. Artificial drainage is needed, and wind erosion must be controlled. This soil is poorly suited to trees. The permeability, high water table, and fine texture in the lower part of this soil severely limit use of the areas for building sites or for intensive recreational development.

Soil management unit 4/1c (IIIw); woodland suitability group W.

Richter Series

Richter soils are moderately dark colored and somewhat poorly drained. These soils are made up of moderately sandy outwash. The original vegetation was chiefly stands of mixed upland and lowland hardwoods that included some willow and tag alder.

Representative profile of Richter loamy sand in a cultivated field:

0 to 6 inches, very dark brown, very friable loamy sand.
6 to 9 inches, pale-brown, very friable loamy sand.
9 to 13 inches, strong-brown, friable sandy loam.
13 to 23 inches, dark reddish-gray, firm, very friable sandy clay loam.
23 to 42 inches +, thin layers of yellowish-brown loamy sand and sandy loam; distinct mottles.

In wooded areas the top layer is very dark gray and only 1 to 3 inches thick. The surface layer ranges from loamy sand to sandy loam or loam. The texture throughout the profile varies considerably within a short distance. The material below a depth of 16 inches consists of a series of thin layers, each one having a different texture than the one above and below. In these places the layers are generally sandy loam or loamy sand in texture. In many areas thin layers of sand are in the profile. The soils are slightly acid to slightly alkaline in the upper part and mildly alkaline or limy below a depth of 1 to 2 feet. Slopes range from 0 to 6 percent but are chiefly 0 to 2 percent.

Permeability of these soils is moderately rapid. Runoff is slow.

Most areas of these soils are in woodland or pasture. A small acreage is in crops.

Richter loam, 0 to 2 percent slopes (RaA).—This nearly level soil is generally next to lower areas of Tonkey soils. The surface layer is generally loam but is sandy in a few areas. A few small areas have short slopes of slightly more than 2 percent.

Included with this soil are a few, small, low areas of Tonkey soils. In a few places coarse sand and gravel are at a depth below 3 feet, and in these areas the soils are similar to the Gladwin soils.

Most of this Richter soil is used for crops, to which it is moderately well suited. Yields are moderate to moderately high. Artificial drainage is needed for adequate yields. This soil is moderately well suited to poorly suited to trees. Limitations to use of the areas for building sites or for intensive recreational development are moderate because of the seasonal high water table.

Soil management unit 3b (IIw); woodland suitability group G.

Richter loamy sand, 0 to 2 percent slopes (RbA).—This soil is nearly level. The surface layer is dominantly loamy sand but is sandy loam, loamy fine sand, or sand in small areas. In a few areas slopes are short and are more than 2 percent.

Included with this soil are small areas of the poorly drained Tonkey soils in shallow depressions and along minor natural drainageways. Also included are fairly large areas of the Gladwin soils that are dominantly coarse sand and gravel in the lower part, and smaller areas of the Wainola soils that are dominantly sand and fine sand in the lower part.

Much of this Richter soil is in crops, to which it is moderately well suited. Yields of grain and hay are moderate to moderately high, but yields of field beans and sugarbeets are low. Artificial drainage is needed, and wind erosion must be controlled. This soil is moderately well suited to poorly suited to trees. Limitations to use of the areas for building sites or for intensive recreational development are moderate because of the seasonal high water table.

Soil management unit 3b (IIw); woodland suitability group G.

Richter sandy loam, 0 to 2 percent slopes (RcA).—This soil is nearly level. The surface layer is dominantly sandy loam, but it is loamy sand or fine sandy loam in small areas. A few short slopes are more than 2 percent.

Included with this soil are small areas of the poorly drained Tonkey soils in shallow depressions and along minor natural drainageways. Also included are fairly large areas of the Gladwin soils that are dominantly coarse sand and gravel in the lower part, and smaller areas of Brimley soils that are dominantly silty in the lower part.

Much of the acreage of this Richter soil is in crops, to which this soil is moderately well suited. Yields are moderate to moderately high. Artificial drainage is needed for adequate yields. This soil is moderately well suited to poorly suited to trees. Limitations to use of the areas for building sites or for intensive recreational development are moderate because of the seasonal high water table.

Soil management unit 3b (IIw); woodland suitability group G.

Richter sandy loam, 2 to 6 percent slopes (RcB).—This soil is gently sloping. Slopes seldom are more than 6 percent but in some places are less than 2 percent. In a few areas most of the original surface layer has been removed through erosion, and the present plow layer is a mixture of the original second and third layers.

Included with this soil are the Tonkey soils, in some low areas, and a few soils in higher areas that are moderately well drained. Also included are the Gladwin soils that are dominantly gravel in the lower part, and Brimley soils that are dominantly silty in the lower part.

Much of this Richter soil is in crops, to which it is moderately well suited. Yields of grain and hay are moderate, but yields of field beans and sugarbeets are low. Artificial drainage is needed, and wind and water erosion must be controlled. This soil is moderately well suited to poorly suited to trees. Limitations to use of the areas for building sites or for intensive recreational development are moderate because of the seasonal high water table.

Soil management unit 3b (IIw); woodland suitability group G.

Richter association (Re).—This mapping unit is nearly level. It is on terraces and outwash plains. Most areas have slopes of 2 percent or less, but in a few small areas, slopes are as much as 6 percent.

The Richter soils are dominant in this mapping unit. These soils are somewhat poorly drained and are mottled at a depth of 2 feet or less. Their soil profile consists of a series of thin layers that alternate between loamy sand and sandy loam in texture.

Small areas of the poorly drained to very poorly drained Tonkey soils are also in this mappnig unit. Their texture is similar to that of the Richter soils, but they are darker colored. In some areas the upper part of the profile is loamy sand, but the lower part is very fine sand or silt. Other soils in this mapping unit are of the Ingalls and Burleigh series.

The largest acreage of this mapping unit is on a low terrace of the Rifle River northwest of Omer. Part of this mapping unit has been cleared and is used as pasture, but some areas remain in trees. Use of this mapping unit for crops is limited, and yields are moderate to low. The value of the areas for woodland is low. Before using the areas for intensive purposes, a study of the particular area should be made on the site.

Soil management unit 3b (IIw); woodland suitability group G.

Rifle Series

In the Rifle series are dark-colored soils that are very poorly drained. These soils consist of acid peat and muck more than 42 inches thick. The original vegetation was stands of elm, ash, cedar, tamarack, and willow.

Representative profile of Rifle peat:

0 to 21 inches, dark grayish-brown, granular peat; contains partly decomposed remains of woody and grassy plants.
21 to 36 inches, black and dark reddish-brown, fibrous peat; consists chiefly of the partly decomposed remains of reeds and sedges.
36 to 42 inches +, brown peat; contains partly decomposed remains of woody and grassy plants in places.

The proportion of peat and muck in the soils varies, and also the degree to which the plant materials have decomposed. The organic layers have a total thickness of at least 42 inches. Layers of mineral soil are at a depth of 42 to 60 inches in some areas. The peat is black, reddish brown, or yellowish brown. The profile is very strongly acid to strongly acid. Partly rotted logs are in the profile in some places.

Permeability of these soils is moderate. Runoff is very slow to ponded.

Rifle peat (Rf).—This is the only Rifle soil mapped in the county. It is nearly level. The largest acreage is in the eastern part of Whitney Township. In a few small areas, the organic material that makes up this soil is less than 42 inches thick.

Included with this soil are some very acid Greenwood soils and some less acid Carbondale soils.

Most areas of Rifle peat are in native trees. Use of this soil for crops is limited, because it is strongly acid, low in fertility, wet, and subject to frost and wind erosion. This soil is poorly suited to trees. Limitations to use of the areas for building sites and for intensive recreational development are severe because of the instability of the soil.

Soil management unit Mc (IIIw); woodland suitability group J.

Roscommon Series

The Roscommon series consists of dark-colored, poorly drained and very poorly drained soils formed in sandy outwash. Lowland forests consisting of elm, ash, aspen, black spruce, and white-cedar made up the original vegetation.

Representative profile of Roscommon loamy sand in a wooded area:

0 to 4 inches, black, very friable loamy sand.
4 to 25 inches, dark grayish-brown, loose sand mottled with light gray and light brownish gray.
25 to 45 inches, pale-brown, loose sand mottled with dark brown and dark grayish brown.
45 inches +, grayish-brown, loose sand; faint mottles of very pale brown.

The surface layer is sand or loamy sand. In some places a thin layer of muck is on the surface, and in others the surface layer has a high content of organic matter. In plowed fields the plow layer ranges from grayish brown to dark grayish brown. Mottling is quite distinct in the less poorly drained areas but fades in the very poorly drained areas. The uppermost layers are medium acid to neutral. Depth to limy material ranges from 10 inches to more than 5 feet. In many places material of finer texture than sand is at a depth below 42 inches. Slopes are less than 2 percent.

Permeability of these soils is very rapid. Runoff is very slow to ponded.

Roscommon loamy sand (Rg).—This soil is in nearly level or depressional areas. The surface layer is dominantly loamy sand but is sand, mucky sand, and fine sand in small areas. In places in wooded areas the surface layer is muck that is as much as 2 feet thick.

Included with this soil are small areas of Tobico soils that are limy within 10 inches of the surface. Also included are small areas of the sandy Pinconning and Brevort soils that are underlain by finer textured material at a depth of less than 42 inches. Also included are a few small areas of Saugatuck soils that are firmly cemented in part of their second layer.

Most areas of this Roscommon soil are wooded, but a few areas are pastured. This soil is moderately well suited to poorly suited to crops. The kinds of crops that can be grown are limited, and yields are moderate to low for those grown. Beans and sugarbeets are not suited. Wetness, wind erosion, and low fertility and moisture-supplying capacity are the main problems. This soil is poorly suited to trees. Because of the high water table, use of the areas for building sites or for intensive recreational development is severely limited.

Soil management unit 5c (IVw); woodland suitability group Q.

Roscommon sand (Rh).—This soil is in nearly level to depressional areas. Although the surface layer is sand, in some areas its organic content is high. In small areas the soil is extremely acid. Some wooded areas have as much as 2 feet of muck on the surface.

Included with this soil are small areas that are limy within 10 inches of the surface. Also included are small areas of sandy Pinconning and Brevort soils underlain by finer textured material at a depth of less than 42 inches. Other included soils are a few areas of the Saugatuck that are firmly cemented in part of their second layer.

Because of drainage problems only a small acreage of Roscommon sand is farmed. Much of the acreage is in second-growth forest or is idle. The soil is poorly suited to crops and is not suited to field beans or sugarbeets. Yields of corn and oats are low. Wetness, wind erosion, and low fertility and moisture-supplying capacity are the chief problems. This soil is poorly suited to trees. The high water table severely limits use of the areas for building sites or for intensive recreational development.

Soil management unit 5c (IVw); woodland suitability group Q.

Roscommon association (Rk).—This mapping unit is on low outwash plains in the northwestern part of the county. The water table is at or near the surface all or part of the year. Slopes are 2 percent or less.

Roscommon soils are dominant in this mapping unit. These soils are poorly drained to very poorly drained. They have a thin black surface layer underlain by gray sand. In some areas the surface layer is mucky. In level areas, slightly higher than those occupied by the Roscommon soils, are the Saugatuck soils. In these soils the subsoil is a firmly cemented, sandy hardpan.

Au Gres soils are on numerous low ridges and knolls that have side slopes of less than 6 percent. These soils are somewhat poorly drained and are strongly mottled at a depth of 12 to 30 inches. The Roscommon, Au Gres, and Saugatuck soils are sandy throughout.

In some depressions within this mapping unit are shallow muck and peats. Some of these are leatherleaf bogs, and in these the Dawson soils predominate. Dawson soils consist of 12 to 42 inches of very acid peat over acid sand. In small muck or peat areas that are less acid than the leatherleaf bogs are the Adrian soils. The vegetation in these areas is sedges, tag alders, and willows.

This mapping unit has little agricultural value. The present cover in the low level areas is willows and tag alders. Aspens are on the low ridges.

Soil management unit 5c (IVw); woodland suitability group Q.

Roscommon-Au Gres-Rubicon association, undulating (RmB).—This mapping unit is on undulating, sandy outwash plains. Slopes are dominantly between 2 and 12 percent but are outside these limits in small areas. The slopes are short, and the individual ridges and depressions are small in size.

The Roscommon, Au Gres, and Rubicon soils are dominant in this mapping unit. They are sandy throughout. Roscommon soils, in the lowest areas, are poorly drained to very poorly drained. They have a thin black surface layer and are underlain by gray sand. The Au Gres soils are slightly better drained than the Roscommon soils and are mottled at a depth of 18 to 36 inches. These soils are on the lower slopes of knolls and ridges within this land type. On the upper slopes and tops of the ridges are the well drained to moderately well drained Rubicon soils. These soils are brighter colored than the Au Gres soils and are free of mottling to a depth of 3 feet or more.

In small depressions within this mapping unit are pockets of shallow muck or peat. Here the soils resemble those of the Adrian and Tawas series.

The largest acreage of this mapping unit is east of State Highway 76, between Alger and Sterling. The area is forested. Aspen and red oak are predominant on the high areas, and tag alder and willow in the low areas. This mapping unit has little value as farmland.

Soil management unit 5c (IVw); woodland suitability group Q.

Rousseau Series

The Rousseau soils are light colored and well drained to moderately well drained. These soils formed in deposits of outwash composed of thin layers of fine and medium sand. The original forests included various kinds of trees, but maple and white pine were dominant.

Representative profile of Rousseau loamy fine sand in a cultivated field.

0 to 6 inches, brown, very friable loamy fine sand.
6 to 8 inches, pinkish-gray, loose fine sand.
8 to 13 inches, brown, very friable loamy fine sand.
13 to 22 inches, strong-brown, loose fine sand.
22 to 42 inches +, thin layers of yellowish-brown to pale-brown, loose fine sand and medium sand.

In uncultivated areas the first layer is thinner and darker colored than described. The second layer is absent in some areas that have been deeply plowed. In a few places chunks of firmly cemented material are in the third and fourth layers. The thin layers of fine sand and medium sand below vary considerably in thickness and order of occurrence within a short distance. Layers of coarse sand, gravel, silt, and clay loam also are present in some places, and they generally are at a depth of more than 3 feet. In some places the soil is mottled below a depth of 42 inches. These soils range from strongly acid to slightly acid. Slopes range from 0 to 18 percent.

Permeability of these soils is rapid. Runoff is slow.

Rousseau loamy fine sand, 0 to 2 percent slopes (RoA).—This nearly level soil is on terraces and outwash plains. It is moderately well drained. In some cultivated areas plowing is as deep as the original third layer and has brought brown soil from this layer to the surface.

Included with this soil are a few low areas of the somewhat poorly drained Wainola soils. Also included are Rubicon soils that have a thick layer of loam to clay at a depth of 42 to 66 inches or that lack layers of fine sand.

This Rousseau soil is somewhat droughty and is subject to wind erosion. It is moderately well suited to poorly suited to crops, and some areas are in crops. This soil is not suited to field beans or sugarbeets, and yields of other crops are moderate to low. It is moderately well suited to trees. Limitations to use of the areas for building sites or for recreational sites are slight.

Soil management unit 4aA (IIIs); woodland suitability group C.

Rousseau loamy fine sand, 2 to 6 percent slopes (RoB).—This soil is gently sloping and is well drained to moderately well drained. The surface layer is loamy fine sand in most areas, but it is fine sandy loam or fine sand in small areas. In small areas the present plow layer includes some material from the original third layer.

Slopes are dominantly between 2 and 6 percent but are outside these limits in small areas.

Included with this soil are somewhat poorly drained Wainola soils in shallow depressions and along minor natural drainageways. Also included are Rubicon soils that have a layer of loam to clay at a depth of 42 to 66 inches.

This Rousseau soil is subject to wind erosion and is droughty. It is poorly suited to crops. This soil is not suited to field beans or sugarbeets, and yields of other crops are moderate to low. It is moderately well suited to trees. Limitations to use of the areas for building sites and recreation sites are slight.

Soil management unit 4aBC (IIIs); woodland suitability group C.

Rousseau loamy fine sand, 12 to 18 percent slopes (RoD).—This strongly sloping soil is on the sides of hills and is well drained. The largest acreage is made up of abandoned fields on the slopes to Big Creek, in the western part of Mason Township. In places all of the original surface layer has been lost through erosion, and in these the present plow layer consists mainly of material from the original third layer. In places layers or chunks of clay loam or other clayey material are at a depth below 3 feet. In a few places gullies have started. The surface layer is fine sand in a few areas. In some areas slopes are less than 12 percent.

Steep slopes, droughtiness, and the hazards of wind and water erosion make this soil unsuited to cultivated crops. Hay and pasture crops are moderately well suited. This soil is also moderately well suited to trees. The slope somewhat limits use of the areas for building sites and for intensive recreational development.

Soil management unit 5/2aC (IVe); woodland suitability group C.

Rubicon Series

Soils of the Rubicon series are light colored and well drained. They formed in thick deposits of sand. The original vegetation was chiefly stands of red and white pines but included some jack pines and northern hardwoods.

Representative profile of Rubicon sand in a wooded area:

0 to 2 inches, very dark gray, very friable sand.
2 to 6 inches, light brownish-gray, loose sand.
6 to 9 inches, strong-brown, very friable sand that contains a few weakly cemented chunks of sand.
9 to 22 inches, yellowish-brown, very friable sand.
22 inches +, light yellowish-brown, loose sand.

In cultivated fields the first and second layers are mixed together to form a very dark grayish-brown plow layer. In eroded areas the plow layer contains some material from the third layer. In many places the third and fourth layers appear as one layer, and the weakly cemented chunks are lacking in many places. The lower part of the fifth layer is faintly mottled where drainage is moderately good. The profile is medium sand throughout, but small amounts of gravel are in the fifth layer in some profiles. In some areas loam to clay is at a depth of more than 42 inches. Slopes are mainly less than 6 percent but range from 0 to 45 percent. The profile is slightly acid to strongly acid.

Permeability of these soils is rapid. Runoff is slow.

Rubicon loamy sand, moderately fine substratum, 0 to 6 percent slopes (RpB).[3]—This soil is nearly level to gently sloping and is well drained and moderately well drained. The surface layer is dominantly loamy sand but is sand or fine sand in small areas. A layer of loam to clay loam is at a depth of 42 to 66 inches. In a few areas plowing is as deep as the brown subsoil and has brought some of this material to the surface. Slopes are dominantly between 2 and 6 percent but are outside these limits in small areas.

Included with this soil are somewhat poorly drained Au Gres soils in a few depressions and along small natural drainageways. Also included are Manistee and Menominee soils, which consist of sandy material less than 42 inches thick, and other soils, which consist of sandy material more than 60 inches thick.

Areas of this Rubicon soil are small and are used for crops or for trees. This soil is droughty; its fertility is very low. It is poorly suited to crops and is only moderately well suited to trees. Limitations to use for building sites or for recreation sites are few.

Soil management unit 5/2aAB (IIIs); woodland suitability group C.

Rubicon loamy sand, moderately fine substratum, 6 to 12 percent slopes (RpC).[4]—This moderately sloping soil is well drained. The surface layer is mainly loamy sand but is sand or fine sand in small areas. A layer of loam to clay loam is at a depth of 42 to 66 inches. In small areas plowing is as deep as the brown subsoil and has brought some of this material to the surface. Slopes are dominantly between 6 and 12 percent but are outside these limits in small areas.

Included with this soil are some soils that are moderately well drained. Also included are Manistee and Menominee soils, in which sandy material is less than 42 inches thick, and other soils, which consist of sandy material more than 60 inches thick.

Areas of this Rubicon soil are small and are used for crops or trees. This soil is droughty and its fertility is very low. It is poorly suited to crops and only moderately well suited to trees. Limitations to use for building sites and for recreation sites are slight.

Soil management unit 5/2aC (IVe); woodland suitability group C.

Rubicon sand, 0 to 6 percent slopes (RsB).—This soil is nearly level to gently sloping and is well drained. In a few areas the third layer is very dark colored and quite firmly cemented. In a few small areas, the sand is underlain by loamy or clayey material at a depth of 42 to 66 inches. Small areas in cultivated fields are slightly eroded, and here part of the original surface layer has been removed. In some areas the slopes are short and choppy.

Included with this soil are the somewhat poorly drained Au Gres soils in depressions and on the lower slopes of minor ridges.

Most areas of this Rubicon soil are wooded, but small areas are cultivated. This soil has very low moisture-supplying capacity and fertility and is not suited to crops. It is poorly suited to trees. Limitations to use of the areas for building sites or for intensive recreational development are slight.

[3] Shown as Melita in material published by the Michigan Agricultural Experiment Station.

[4] Shown as Melita in material published by the Michigan Agricultural Experiment Station.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Rubicon sand, 6 to 12 percent slopes (RsC).—This moderately sloping soil is on beach ridges and outwash plains. It is well drained. Slopes are dominantly between 6 and 12 percent but are outside these limits in small areas. A forest cover has protected this soil from severe erosion, but a few areas are slightly eroded. In some areas the profile is fine sand.

Included with this soil are small areas of soils that are moderately well drained. Also included are a few areas of sandy soils that are underlain by loamy or clayey material at a depth of 42 to 66 inches.

Most areas of this Rubicon soil are wooded. This soil is droughty, very low in fertility, and subject to wind erosion. It is not suited to crops and is poorly suited to trees. Use of this soil for building sites or for intensive recreational development is somewhat limited.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Rubicon sand, 12 to 18 percent slopes (RsD).—This strongly sloping soil is well drained. Slopes are dominantly between 12 and 18 percent but are outside these limits in small areas. A forest cover has protected this soil from severe erosion, but a few areas are slightly or moderately eroded.

All areas of this Rubicon soil are wooded. This soil is droughty, is very low in fertility, has moderately steep slopes, and is subject to wind erosion. It is not suited to crops and is poorly suited to trees. Limitations to use of the areas for building sites or for intensive recreational development are moderate.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Rubicon sand, 18 to 25 percent slopes (RsE).—This hilly soil is well drained. Slopes are dominantly between 18 and 25 percent but are outside these limits in small areas. A forest cover has protected this soil from severe erosion, but a few areas are slightly eroded and moderately eroded.

All areas of this Rubicon soil are wooded. This soil is droughty, very low in fertility, has steep slopes, and is subject to wind erosion. It is not suited to crops and is poorly suited to trees. Limitations to use of this soil for building sites or intensive recreational development are moderate to severe.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Rubicon sand, 25 to 45 percent slopes (RsF).—This soil is steep and is well drained. Slopes are dominantly more than 25 percent but are less than this in small areas. A forest cover has protected this soil from severe erosion, but a few areas are slightly or moderately eroded.

All areas of this soil are wooded. This soil is droughty, very low in fertility, has steep slopes, and is subject to wind erosion. It is not suited to crops and is poorly suited to trees. Limitations to use of this soil for building sites or for intensive recreational development are moderate to severe.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Rubicon sand, moderately fine substratum, 0 to 6 percent slopes (RtB).[5]—This nearly level to gently sloping soil is in high areas and is moderately well drained. A layer of loam to clay loam is at a depth of 42 to 66 inches. The surface layer is dominantly sand but is sand or fine sand in small areas. In a few areas plowing has brought some material from the brown subsoil to the surface. Slopes are more than 6 percent in small areas.

Included with this soil, in a few shallow depressions and along minor natural drainageways, are the somewhat poorly drained Au Gres soils. Also included are Manistee and Menominee soils, which consist of sandy material less than 42 inches thick, and other soils, which consist of sandy material more than 66 inches thick.

Areas of this Rubicon soil are in crops or are wooded. This soil is poorly suited to crops because it is droughty and its fertility is very low. It is moderately well suited to trees. Limitations to use of the areas for building sites or for recreation sites are slight.

Soil management unit 5/2aAB (IIIs); woodland suitability group C.

Rubicon sand, moderately fine substratum, 6 to 12 percent slopes (RtC).[6]—This moderately sloping soil is dominantly well drained. It has a layer of loam to clay loam at a depth of 42 to 66 inches. Slopes are dominantly between 6 and 12 percent but are outside these limits in small areas. The surface layer is dominantly sand but is loamy sand or fine sand in a few areas. Plowing has brought material from the brown subsoil to the surface in a few areas.

Included with this soil are small areas of Manistee and Menominee soils that consist of sandy material less than 42 inches thick. Also included are soils that consist of sandy material more than 66 inches thick.

Areas of this Rubicon soil are used for crops or pasture or are wooded. This soil is poorly suited to crops because it is droughty and its fertility is very low. It is moderately well suited to trees. Limitations to use for building sites and recreation sites are slight.

Soil management unit 5/2aC (IVe); woodland suitability group C.

Rubicon sand, moderately fine substratum, 12 to 18 percent slopes (RtD).[7]—This strongly sloping soil is well drained. A layer of loam to clay loam is at a depth of 42 to 66 inches. Slopes are dominantly between 12 and 18 percent but are outside these limits in small areas. A cover of grass and trees has protected the areas from erosion, and the areas therefore are only slightly eroded or are not eroded.

Included with this soil are areas of Menominee and Manistee soils, in which sandy material is less than 42 inches thick.

This Rubicon soil is not suited to crops, because of its very low fertility, droughtiness, slope, and hazard of erosion. It is moderately well suited to trees. Limitations to use of this soil for building sites or for recreation sites are moderate to severe.

Soil management unit 5/2aC (IVe); woodland suitability group C.

Rubicon association, undulating (RuB).—This mapping unit is on nearly level outwash plains. The water table is at sufficient depth that the soils are well drained and moderately well drained. Slopes are short and are mostly

[5] Shown as Melita in material published by the Michigan Agricultural Experiment Station.

[6] Shown as Melita in material published by the Michigan Agricultural Experiment Station.

[7] Shown as Melita in material published by the Michigan Agricultural Experiment Station.

less than 6 percent. A forest cover protects the soil from severe wind erosion, and rapid permeability of the soils prevents erosion by runoff.

The Rubicon soils are dominant in this mapping unit. These soils are sandy to a depth of 5 feet or more, and are free of mottling to a depth of 3 feet or more. In some of the low level areas are the somewhat poorly drained Au Gres soils. These soils have darker and duller colors than the Rubicon soils and are mottled at a depth of less than 18 inches.

Areas of this mapping unit are extensive in the northwestern part of the county. The areas are not farmed and are in second-growth forest, in which aspen and oak are dominant. The very low fertility and moisture-supplying capacity, and the hazard of wind erosion, make these soils unsuited to crops and poorly suited to trees. Limitations to use of these soils for building sites or for intensive recreational development are moderate.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Rubicon association, rolling (RuC).—This mapping unit is on rolling outwash plains and on sand dunes that are well stabilized. Slopes are short and range from 6 to 18 percent over most of the area. The ridges and hills have no definite pattern and include many closed depressions.

The Rubicon soils are dominant. These soils are well drained to moderately well drained and are sandy to a depth of more than 5 feet. In some places the profile contains much fine sand, but in general, medium sand predominates. The Rubicon soils are bright colored and are free of mottling to a depth of more than 3 feet.

In some depressions, as well as on some low slopes, are the somewhat poorly drained Au Gres soils. In texture these soils are similar to the Rubicon soils, but their color is darker and duller and they are mottled at a depth of less than 18 inches. In the lowest and wettest areas are the poorly drained to very poorly drained Roscommon soils. These soils have a thin black surface layer and are underlain by gray sand.

Some of this mapping unit is covered with second-growth forest, in which aspen and oak are dominant. Because of the slope, very low fertility and moisture-supplying capacity, and hazard of wind erosion, this mapping unit is not suited to crops and is poorly suited to trees. Limitations to its use for building sites or for intensive recreational development are moderate to severe.

Soil management unit 5.3aCF (VIIs); woodland suitability group H.

Rubicon-Iosco association, undulating (RvB).—This mapping unit is on till plains that have a cover of outwash sand. The sand ranges from 18 inches to more than 5 feet in thickness and is underlain by finer textured material. The mapping unit consists of low ridges and intervening flat or depressional areas. Originally the surface of the till plains was nearly level. Variations in the thickness of the sand cover are the main cause of the present undulating relief. Depth to till is therefore less in the low areas than in the high areas. Most of the ridges have side slopes of 2 to 10 percent and are 5 to 15 feet above the surrounding land, but in a few places the ridges are higher and steeper.

The moderately fine substratum phases of the Rubicon soils are dominant on the slopes and the tops of the ridges. These soils are sandy throughout and are well drained to moderately well drained. They are brightly colored and are free of mottling to a depth of more than 3 feet. These soils are underlain by loam to clay at a depth of 42 to 66 inches.

The low slopes and level areas between the ridges are occupied by the Iosco soils. Because of somewhat poorer natural drainage, these soils are darker and duller in color than the Rubicon soils. Iosco soils are sand to loamy sand to a depth of 18 to 42 inches. Below is glacial till of loam, clay loam, or silty clay loam texture.

Minor areas of those Au Gres soils that have a loamy substratum, and of the Brevort and Roscommon soils are also in this mapping unit. These soils differ in drainage and in thickness of sandy material. The somewhat poorly drained Au Gres soils that have a loamy substratum are quite extensive on the lower slopes of the ridges. They consist of sandy material 42 to 66 inches thick over finer textured material. In small areas where the finer textured material is lacking there are Roscommon soils. The Roscommon soils are poorly drained to very poorly drained. They formed in sandy deposits slightly more than 42 inches thick. Brevort soils are poorly drained and very poorly drained. They formed in sandy deposits 18 to 42 inches thick over clay loam.

All of this mapping unit is in second-growth forest, in which aspen and oak are dominant. The largest acreage is west of State Highway 76, between Alger and Sterling. The soils in this mapping unit are of little value for tilled crops or tame pasture; they are moderately well suited to poorly suited to trees. Limitations to use for building sites or for intensive recreational development are moderate and depend on the area being considered. Limitations are severe for the wetter soils.

Soil management unit 5/2aAB (IIIs); woodland suitability group C.

Rudyard Series

Soils of the Rudyard series are moderately dark colored and somewhat poorly drained. These soils formed in clayey deposits in lakebeds. The original vegetation was stands of mixed hardwoods.

Representative profile of Rudyard silty clay loam in an undisturbed area:

0 to 4 inches, very dark grayish-brown, firm silty clay loam.
4 to 7 inches, light brownish-gray, firm silty clay loam.
7 to 20 inches, dark reddish-gray, firm silty clay; sticky when wet; faintly mottled.
20 to 42 inches +, brown, firm, limy clay; sticky when wet; mottled with yellowish brown.

In most cultivated fields plowing has combined the first and second layers to form a very dark grayish-brown plow layer. The third and fourth layers are clay or silty clay. Depth to the limy fourth layer ranges from 18 to 30 inches. In some areas thin layers of silty material are within the third and fourth layers. The surface layer is slightly acid to moderately alkaline. Slopes range from 0 to 2 percent.

Permeability of these soils is slow. Runoff also is slow.

Rudyard silty clay loam, 0 to 2 percent slopes (RyA).—This is the only Rudyard soil mapped in the county. It is nearly level. The surface layer is generally silty clay loam but is silt loam or clay loam in a few areas. Depth

to the underlying silty clay or clay is about 6 to 12 inches. Slopes are more than 2 percent in a few small areas.

Included with this soil are Pickford soils in shallow depressions and along minor natural drainageways.

If this soil is drained, it is well suited to crops. All of the crops common to the county can be grown, and yields are moderately high. Wetness is a hazard, and tillage must be carefully done because of the fine texture of this soil. This soil is poorly suited to trees. Limitations to use for building sites and for recreational development are severe because of the seasonal high water table and the fine texture of this soil.

Soil management unit 1b (IIIw); woodland suitability group Z.

Saganing Series

In the Saganing series are dark-colored, poorly drained soils. These soils formed in sandy loam and are underlain by loose sand and gravel at a depth of 15 to 36 inches. The original vegetation was stands of lowland conifers.

Representative profile of Saganing sandy loam in a cultivated field:

0 to 8 inches, very dark gray, very friable sandy loam.
8 to 13 inches, light brownish-gray, very friable sandy loam.
13 to 24 inches, light-gray, firm sandy loam mottled with yellowish brown.
24 to 42 inches +, light-gray, loose, limy sand.

In some undisturbed areas the surface layer is muck and is 2 to 8 inches thick. The first three layers combined are 15 to 36 inches thick. Their texture is dominantly sandy loam, but it ranges to fine sandy loam. Below a depth of 15 to 36 inches, the soils are limy. Slopes are 0 to 2 percent.

Permeability of these soils is moderately rapid. Runoff is very slow to ponded.

Saganing sandy loam (Sa).—This is the only Saganing soil mapped in the county. It is nearly level and is on outwash plains. The surface layer is loam or loamy sand in small areas. In places the upper layers are dominantly loam or sandy clay loam.

Most areas of this soil are in crops. Hay and pasture crops are grown in most places, but small areas are in corn and field beans. This soil is moderately well suited to crops. Wetness, moderate fertility, and difficulty of maintaining artificial drainage are the main problems. This soil is poorly suited to trees. Limitations to use of this soil for building sites or for intensive recreational development are severe because of the high water table.

Soil management unit 4c (IIIw); woodland suitability group W.

Saugatuck Series

Soils of the Saugatuck series are dark colored and somewhat poorly drained to poorly drained. These soils are sandy and have a subsoil that is a firmly cemented, sandy hardpan. The original vegetation was sparse stands of aspen, cedar, and black spruce that had a ground cover of mosses and ferns.

Representative profile of Saugatuck loamy sand in a cultivated field:

0 to 8 inches, very dark gray, very friable loamy sand.
8 to 14 inches, light-gray, loose sand.
14 to 18 inches, dark reddish-brown loamy sand that is cemented.
18 to 22 inches, dark-brown sand that is slightly cemented and contains chunks of strongly cemented material.
22 to 42 inches +, strong-brown to brown, loose sand; strongly mottled.

In unplowed areas the surface layer is black and is 1 to 5 inches thick. The third layer is 3 to 10 inches thick. Part of this layer is very firmly cemented, and the rest is moderately or weakly cemented. The fifth layer is brown to gray in color and generally is mottled. It consists in places of several layers that differ from each other in the amount and color of mottling. A layer of loam to clay is below a depth of 42 inches in a few places. Texture of the surface layer and the hardpan is sand or loamy sand, but all other layers are sand in texture. The upper four layers are strongly acid to medium acid. In places the sandy material is limy at a depth below 3 feet. Slopes are less than 2 percent.

Permeability is rapid in the upper two layers of these soils, slow in the third and fourth layers, and rapid in the fifth layer. Runoff is very slow.

Saugatuck loamy sand (Sb).—This soil is in level to depressional areas and on very gentle slopes that surround these areas. The surface layer is generally loamy sand to a depth of 6 to 8 inches, but in many areas it is sand.

Included with this soil are small areas of Au Gres and Roscommon soils that have a weakly cemented layer or that lack a cemented layer. Also included are a few areas of soils that are less than 42 inches thick over loam to clay loam.

Because individual areas of this soil are small, they are used the same as soils that surround them. This soil is not suited to crops and is poorly suited to trees. Wetness severely limits use of the areas for building sites and for intensive recreational development.

Soil management unit 5b–h (VIIw); woodland suitability group F.

Saugatuck sand (Sc).—This soil is in level to depressional areas and on very gentle slopes that surround these areas. The soil is sand throughout the profile.

Included with this soil are small areas of Au Gres and Roscommon soils that have a weakly cemented layer or that lack a cemented layer. Also included are a few areas of soils that are less than 42 inches thick over loam to clay loam.

Because individual areas of this soil are small, they are used the same as soils that surround them. This soil is not suited to crops and is poorly suited to trees. Wetness severely limits use of the areas for building sites and for intensive recreational development.

Soil management unit 5b–h (VIIw); woodland suitability group F.

Selkirk Series

Soils of the Selkirk series are moderately dark colored and somewhat poorly drained. These soils formed in clayey glacial till. The original vegetation was chiefly forests of northern hardwoods but included some cedars and hemlocks.

Representative profile of Selkirk loam in a cultivated field:

0 to 9 inches, very dark grayish-brown, friable loam.
9 to 11 inches, light brownish-gray, friable silt loam.
11 to 21 inches, reddish-brown clay; well-defined angular blocky structure; firm when moist, sticky when wet.
21 to 42 inches +, reddish-brown, limy clay; generally mottled; firm when moist, sticky when wet.

In cultivated areas the surface layer is very dark grayish brown and is 1 to 3 inches thick. In these places the second layer is correspondingly thicker than described. In some places plowing is as deep as the third layer of clay, and here the second layer is lacking. The texture of the first and second layers ranges from loamy sand to silty clay loam. Depth to clay ranges from less than 12 to 18 inches, but clay is generally at a depth of less than 12 inches. The third and fourth layers are clay or silty clay, and the third layer contains more clay than the fourth. The fourth layer is limy and is at a depth ranging from 14 to 25 inches. The first three layers are slightly acid to mildly alkaline. Generally the fourth layer is mottled, and in many areas the third layer is faintly mottled. In the wettest areas mottling is higher in the profile than in areas not so wet. Slopes range from 0 to 6 percent but are dominantly from 0 to 2 percent.

Permeability of these soils is slow. Runoff is also slow.

Most areas of these soils are in crops. They are well suited to crops if drained, and some areas have been drained.

Selkirk fine sandy loam, 0 to 2 percent slopes (SdA).—This nearly level soil is sandy to a depth of 8 to 18 inches in most places, but in small areas it is sandy to a greater depth. In some small areas the surface layer is loamy fine sand or loam. In a few areas slopes are slightly more than 2 percent.

Included with this soil are Pickford soils in small depressions and along minor natural drainageways.

Most areas of this Selkirk soil are in crops or are in improved pasture. If this soil is drained, it is well suited to crops. Yields of all crops commonly grown are moderately high. Wetness and the fine texture of the subsoil are the main problems. This soil is moderately well suited to poorly suited to trees. The seasonal high water table and fine texture of the subsoil severely limit use of the areas for building sites and for intensive recreational development.

Soil management unit 1b (IIIw); woodland suitability group Z.

Selkirk loam, 0 to 2 percent slopes (SeA).—This nearly level soil is loam to a depth of 8 to 18 inches in most places, but in a few areas it is loam to a greater depth. In small areas the surface layer is fine sandy loam or clay loam. In a few small areas, slopes are more than 2 percent.

Included with this soil are Pickford soils in small depressions and along minor natural drainageways. Also included are a few areas of Kawkawlin soils that have a fourth layer of heavy clay loam.

This Selkirk soil is well suited to crops. Yields of all crops commonly grown are moderately high. Wetness and the fine texture of the subsoil are the chief problems. This soil is moderately well suited to poorly suited to trees. The seasonal high water table and fine texture of the subsoil severely limit use of the areas for building sites and for intensive recreational development.

Soil management unit 1b (IIIw); woodland suitability group Z.

Selkirk loam, 2 to 6 percent slopes (SeB).—This gently sloping soil has slightly better natural drainage than Selkirk loam, 0 to 2 percent slopes. It is loam to a depth of 8 to 18 inches in most areas, but it is loam to a depth of more than 18 inches in a few areas. In small areas the surface layer is sandy loam or clay loam. Slopes seldom exceed 6 percent but in a few small areas are less than 2 percent.

Included with this soil are Pickford soils in small depressions and along minor natural drainageways. On some knolls and ridges are small areas of the moderately well drained Kent soils.

Most areas of this Selkirk soil are in crops or are in improved pasture. This soil is well suited to crops, and yields are moderate to moderately high. Wetness, the fine texture of the subsoil, and in places the hazard of erosion, are the main problems. This soil is moderately well suited to poorly suited to trees. The seasonal high water table and fine texture of the subsoil severely limit use of the areas for building sites and for intensive recreational development.

Soil management unit 1b (IIIw); woodland suitability group Z.

Selkirk loamy sand, 0 to 2 percent slopes (SfA).—This nearly level soil is sandy to a depth of 8 to 18 inches. In small areas the surface layer is sandy loam or loamy fine sand. In a few areas slopes are more than 2 percent.

Included with this soil are small areas of Allendale soils that are sandy to a depth of more than 18 inches. Also included are Pickford soils in small depressions and along minor natural drainageways.

Most areas of this Selkirk soil are in crops or in improved pasture. This soil is moderately well suited to crops, and yields are moderate. Wetness and wind erosion are the main problems. This soil is moderately well suited to poorly suited to trees. The seasonal high water table severely limits use of the areas for building sites and for intensive recreational development.

Soil management unit 1b (IIIw); woodland suitability group Z.

Selkirk silt loam, 0 to 2 percent slopes (SkA).—This nearly level soil is silt loam to a depth of 8 to 18 inches in most areas, but in a few areas it is silt loam to a greater depth. In small areas the surface layer is loam or silty clay loam. Slopes are more than 2 percent in a few small areas.

Included with this soil are Pickford soils in small depressions and along minor natural drainageways. Also included are a few areas of Kawkawlin soils that have a fourth layer of heavy clay loam.

Drainage is restricted in this Selkirk soil. Artificial drainage is needed, and some areas have been drained. If adequately drained, this soil is productive and is well suited to crops or improved pasture. Yields of all crops commonly grown are moderately high. Wetness and the fine texture of the subsoil are the main problems. This soil is moderately well suited to poorly suited to trees. The seasonal high water table and fine texture of the subsoil severely limit use of this soil for building sites and for intensive recreational development.

Soil management unit 1b (IIIw); woodland suitability group Z.

Selkirk silty clay loam, 0 to 2 percent slopes (SlA).—This nearly level soil is silty clay loam to a depth of about 8 to 14 inches. The material below is clay. In a few small areas the surface layer is clay loam or silt loam. Slopes are more than 2 percent in a few small areas.

Included with this soil are Pickford soils in shallow depressions and along minor natural drainageways.

Most areas of this Selkirk soil are in crops or in improved pasture, and some areas have been artificially drained. This soil is well suited to crops, and yields of all crops commonly grown are moderately high. The fine texture and wetness are the main problems and they hinder tillage. This soil is moderately well suited to poorly suited to trees. The seasonal high water table and fine texture of the soil severely limit use for building sites and for intensive recreational development.

Soil management unit 1b (IIIw); woodland suitability group Z.

Sims Series

In the Sims series are dark-colored and poorly drained to very poorly drained soils. These soils formed in loamy glacial till. The original vegetation was swamp hardwoods.

Representative profile of Sims clay loam in a plowed field:

0 to 7 inches, black, firm clay loam.
7 to 15 inches, light brownish-gray, firm clay loam mottled with brown and yellowish brown.
15 to 32 inches, light-gray, firm clay loam mottled with yellowish brown and dark yellowish brown.
32 to 42 inches +, grayish-brown, firm, limy clay loam mottled with yellowish brown and brown.

The surface layer is thicker than depth of plowing in many places, and in these places it consists of two layers, one plowed, and the other just below plow depth. The total thickness of the surface layer is 6 to 10 inches. In some undisturbed areas a layer of muck or peat 1 to 12 inches thick is on the surface. The surface layer ranges from sandy loam to silty clay loam. The second and third layers are finer textured than the other layers in the profile. They range from silty clay loam to light clay. Mottling is most pronounced in the poorly drained areas, and fades in the very poorly drained areas. Depth to the limy fourth layer ranges from 20 to 40 inches. Slopes are less than 2 percent.

Permeability of these soils is moderately slow. Runoff is very slow to ponded.

Sims clay loam (Sm).—This nearly level soil is generally clay loam to silty clay loam throughout. In small areas the surface layer is sandy clay loam and loam, and a few areas have a cover of sandy material. In a few areas the three lower layers are sandy clay loam in places. In a few areas the soil is limy at the surface. Slopes to some shallow natural drainageways are more than 2 percent in a few areas.

Much of this mapping unit has been artificially drained and is in crops. Undrained areas are wooded or pastured. If this soil is drained and otherwise well managed, it is well suited to crops and all crops common to the county can be grown. Yields are high. Wetness and maintenance of soil structure are the main problems. This soil is poorly suited to trees. The high water table and fine texture severely limit use of this soil for building sites and for intensive recreational development.

Soil management unit 1.5c (IIw); woodland suitability group P.

Sims loam (Sn).—This nearly level soil is silt loam to a depth of less than 18 inches. In small areas the surface layer is sandy loam or clay loam, and in a few areas it is loam to a depth of more than 18 inches. In a few places the lowest layer is sandy clay loam. A few areas are limy at or near the surface. Near drainageways a few areas have a cover of sandy or loamy material. Slopes to some shallow natural drainageways are more than 2 percent in a few areas.

Large areas of this soil are artificially drained and are used for forage and grain crops and for sugarbeets, field beans, and cucumbers (fig. 7). Undrained areas are in pasture and woodland. If this soil is drained, it is well suited to crops and all crops common to the county can be grown. Yields are high. Wetness and maintenance of soil structure are the main problems. This soil is poorly suited to trees. The high water table and fine texture severely limit use of the areas for building sites and for intensive recreational development.

Soil management unit 1.5c (IIw); woodland suitability group P.

Sims loamy sand (Sp).—This nearly level soil is generally sandy to a depth of 10 inches, but in some places it is sandy to a depth of about 18 inches. In places the surface layer is sandy loam or loam. The profile contains more sand than the representative profile described for the series. A few areas are limy at or near the surface. Slopes to shallow natural drainageways are more than 2 percent in a few areas.

Included with this soil are a few areas of the better drained Twining and Iosco soils on low knolls and ridges.

Much of this Sims soil is artificially drained and used for crops. Most undrained areas are in pasture or woodland. This soil is moderately well suited to crops. Yields are commonly lower than for the finer textured Sims soils. Wetness and wind erosion are the main problems. This soil is poorly suited to trees. The wetness severely limits use of the areas for building sites or for intensive recreational development.

Soil management unit 1.5c (IIw); woodland suitability group P.

Sims sandy loam (Sr).—This nearly level soil is generally sandy loam or fine sandy loam to a depth of less than 18 inches. In many areas the surface layer is loam, and in a few areas it is sandy loam to a depth of more than 18 inches. In some places the lowest layer is sandy clay loam. A few areas are limy at or near the surface. Near drainageways a few areas have a cover of sandy or loamy material. Slopes to some shallow natural drainageways are more than 2 percent in a few areas.

Large areas of this soil are artificially drained and are used for forage and grain crops and sugarbeets, field beans, and cucumbers. Undrained areas are in pasture or are wooded. This soil is moderately well suited to crops. Yields are somewhat lower than on the finer textured Sims soils. Wetness is the main problem. This soil is poorly suited to trees. The high water table and fine texture of the subsoil severely limit use of this soil for building sites or for intensive recreational development.

Figure 7.—**Field beans and oats on Sims loam.**

Soil management unit 1.5c (IIw); woodland suitability group P:

Stone Quarries

Stone quarries (Su) is a land type made up of small areas from which bedrock has been removed for various purposes. Bedrock is close to the surface, and the areas have little or no value for farming or forestry. Areas of this land type lie idle after quarrying is completed. This land type is not suitable for crops or trees and therefore is not placed in a soil management unit or woodland suitability group.

Summerville Series

Soils of the Summerville series are well drained. They are underlain by limestone bedrock at a depth of 18 inches or less. The original vegetation was stands of balsam, fir, white-cedar, and yellow birch.

Representative profile of Summerville sandy loam in an uncultivated area:

0 to 5 inches, very dark gray, friable sandy loam.
5 to 6 inches, pale-brown, friable sandy loam.
6 to 10 inches, brown, friable sandy loam.
10 inches +, light-gray limestone bedrock.

The first three layers combined range from 8 to 18 inches in thickness. In places where the combined thickness of the three layers is near 8 inches, the second and third layers are very thin or are absent. The three layers are thicker where depth to bedrock is greater. The profile generally is neutral in reaction. Fragments of limestone are scattered throughout the profile. Slopes range from 0 to 6 percent.

Permeability of these soils is moderately rapid in the upper part. Runoff is slow.

Summerville sandy loam, 0 to 2 percent slopes (SvA).—This soil is nearly level. The layers above the bedrock range from loamy sand to loam in texture but are predominantly sandy loam. Slopes are chiefly less than 2 percent but are greater in a few small areas. Outcrops of bedrock are numerous. Many loose fragments of bedrock are on the surface.

Included with this soil are small areas of Duel soils that are more than 18 inches thick over bedrock.

Most areas of this Summerville soil are wooded or pastured. Limestone has been quarried from a few areas. This soil is poorly suited to crops because bedrock is at or near the surface. It is moderately well suited to poorly suited to trees because of nearness of bedrock to the surface. The bedrock must also be considered before using the areas for building sites or for intensive recreation.

Soil management unit RaAB (VIIs); woodland suitability group T.

Summerville sandy loam, 2 to 6 percent slopes (SvB).—This soil is gently sloping. The layers above the bedrock range from loamy sand to loam in texture but are predominantly sandy loam. Slopes are dominantly 2 to 6 percent but are outside these limits in a few small areas. Outcrops of bedrock are numerous. Many, loose fragments of bedrock are on the surface.

Included with this soil are small areas of Duel soils that are more than 18 inches thick over bedrock.

Most areas of this Summerville soil are in woodland and pasture. Limestone has been quarried in a few places. Because bedrock is at or near the surface, this soil is poorly suited to crops and is moderately well suited to poorly suited to trees. Depth to bedrock must be considered before using the areas for building sites or for intensive recreation.

Soil management unit RaAB (VIIs); woodland suitability group T.

Tawas Series

In the Tawas series are very dark colored, very poorly drained soils in nearly level to depressional areas. These soils consist of muck or peat that is underlain by sandy material at a depth of 12 to 42 inches. The original vegetation was northern swamp conifers, such as white-cedar and black spruce, mixed with hardwoods.

Representative profile of Tawas muck in a wooded area:

0 to 12 inches, black, friable muck; contains partly decomposed fragments of wood.
12 to 30 inches, dark-brown, soft, peaty muck.
30 inches +, pale-brown, loose sand; strongly mottled with strong brown, brown, and yellowish brown.

The first two layers consist of muck, peat, or a combination of the two. Their combined thickness ranges from 12 to 42 inches. Chunks of woody material are scattered through these layers. The third layer is sand, loamy sand, loamy fine sand, or fine gravel. It varies considerably in amount and color of mottling. In a few places loamy or clayey materials underlie the third layer at a depth of 42 to 66 inches. Reaction of the upper two layers is medium acid to neutral, but that of the third is generally limy. Slopes are less than 2 percent.

Permeability of these soils is moderately rapid. Runoff is very slow to ponded.

Tawas peat, burned (Tb).—The surface of this soil is pitted. The areas have been severely burned over, and as a result, much of the organic material in the pits has been burned away and the underlying sand exposed. Areas of this soil have little value for farming.

Soil management unit M/4c (IVw); woodland suitability group J.

Tawas peat and muck (Ta).—This nearly level soil has a surface layer of peat, or muck, or mucky peat. In many places in wooded areas, a layer of leaves 2 to 6 inches thick is on the surface. A few areas along small streams have a thin layer of sand on the surface, and a few areas have a hummocky surface because of tree throw.

Included with this soil in mapping are areas of Carbondale soils, in which the muck and peat is more than 42 inches thick, and of Roscommon soils, where such material is less than 12 inches thick. Also included are small areas of the more acid Adrian soils and of the less acid Markey soils.

Tawas peat and muck is mostly wooded. A few small patches are cleared and farmed, and these areas benefit from artificial drainage. The areas are moderately well suited to sugarbeets and in places to truck crops. Areas that are not subject to early frost are moderately well suited to corn. If this soil is tilled, the major hazards are thinness of the peat and muck, the sandy subsoil, wetness, difficulty of drainage and maintenance of the drains, and wind erosion.

This soil is poorly suited to trees. The high water table severely limits use of the areas for building sites or for intensive recreational development.

Soil management unit M/4c (IVw); woodland suitability group J.

Tawas association (Tc).—This mapping unit is in depressions on level, sandy outwash plains where the water table is at or near the surface much of the year. It is surrounded by higher lying sandy soils.

Dominant in this mapping unit are the Tawas soils. These soils consist of peat or muck that is 12 to 42 inches thick over sand. Both granular, black muck and fibrous, yellowish-brown peat generally make up the upper layers, which are medium acid to neutral. The underlying sand is gray and is neutral to limy. Included are areas of the Carbondale soils, in which the thickness of peat or muck is more than 42 inches, and of the Roscommon soils, in which the muck is less than 12 inches thick or is lacking.

This mapping unit has not been cleared or drained and has a cover of native swamp hardwoods, cedars, and rushes. It is poorly suited to crops because it is thin over sand, is wet, and is subject to frost and to wind erosion. It is poorly suited to trees. Also, the high water table severely limits use for building sites or intensive recreational development.

Soil management unit M/4c (IVw); woodland suitability group J.

Tawas-Carbondale association (Td).—This mapping unit is on low outwash plains in the northwestern part of the county where the water table is at or near the surface much of the year. The areas are generally in depressions and are surrounded by higher areas of sandy outwash soils.

The soils of this mapping unit consist of 12 to more than 42 inches of peat or muck, or of a combination of both, and are underlain by sand. In the Tawas soils the muck or peat is 12 to 42 inches thick, but in the Carbondale soils such material is more than 42 inches thick. Both soils are very poorly drained. The organic part of the profile is made up of a number of layers. These layers range from granular, black muck to fibrous, yellow peat. They are strongly acid to neutral. The underlying sand is dull gray and is neutral to limy.

Other soils in this mapping unit are the Au Gres and Roscommon. The somewhat poorly drained Au Gres soils are on a few low ridges that project a few feet above the general level of the peat or muck soils. Au Gres soils are generally sandy. Roscommon soils are in areas where the deposit of muck and peat is less than 12 inches thick.

Typically the pattern of occurrence of the soils is a narrow ring of Roscommon soils on low ridges around a depression. These soils grade to Tawas soils, which in turn give way to Carbondale soils in the center of the depression, where the muck or peat is thickest.

Areas of this mapping unit have not been cleared or drained and have a cover of native swamp hardwoods, cedars, reeds, and sedges. For the most part, the soils have little value for crops, but the Carbondale soils are moderately well suited to crops if not in a frost area. The mapping unit is poorly suited to trees. In most areas the high water table severely limits use for building sites or for intensive recreational development.

Soil management unit M/4c (IVw); woodland suitability group J.

Tawas-Roscommon association (Te).—This mapping unit is on low outwash plains where the water table is at or near the surface much of the year. The areas are generally in depressions, where the slope is slight, and are surrounded by higher sandy areas.

Dominant in this mapping unit are the Tawas soils. These soils consist of peat or muck that is underlain by sand at a depth of 12 to 42 inches. Roscommon soils are sandy but have as much as 12 inches of muck or peat on the surface. Both soils are very poorly drained. The organic layers generally are a combination of granular, black muck and fibrous, yellow peat. These layers are medium acid to neutral. The underlying sand is gray and is neutral to limy.

Also in this mapping unit are a few small areas of Carbondale soils and some Roscommon soils, around the edges of the depressions, that have little or no peat or muck on the surface. Carbondale soils are toward the center of the depressions, where the muck and peat is more than 42 inches thick.

This mapping unit is not used for farming and has a cover of native cedars, swamp hardwoods, and swamp-grass. The soils are poorly suited to crops because of wetness, the thinness of the muck or peat, and the hazards of frost and of wind erosion. The soils are also poorly suited to trees. The high water table severely limits use for building sites or intensive recreational development.

Soil management unit M/4c (IVw); woodland suitability group J.

Tobico Series

In the Tobico series are dark-colored, poorly drained to very poorly drained, limy soils. These soils formed in sand and fine gravel. The original vegetation was northern swamp hardwoods mixed with white-cedar and black spruce.

Representative profile of Tobico loamy fine sand:

0 to 3 inches, black, very friable, limy loamy fine sand; very high in organic matter.
3 to 18 inches, light-gray, loose, limy sand.
18 to 30 inches, very pale brown, loose, limy sand; many yellow mottles.
30 to 42 inches +, light-gray, loose, limy sand.

The surface layer is loamy fine sand or sandy loam. In some undisturbed areas a layer of muck or peat 2 to 10 inches thick is on the surface. In places the surface layer is not limy, and here limy material is at a depth of 10 inches or less. In some areas as much as 20 percent of the third and fourth layers is fine gravel instead of sand. Mottling is most pronounced in the poorly drained areas and fades in the very poorly drained areas. Slopes are 0 to 2 percent.

Permeability of these soils is very rapid. Runoff is slow to ponded.

Tobico loamy fine sand (Tf).—This nearly level soil has a surface layer of loamy fine sand or mucky loamy sand to a depth of 1 foot or less. Below is loose sand and gravel. On a few low sand ridges, slopes are more than 2 percent.

Included with this soil are small areas of Roscommon soils that are more than 10 inches deep to limy material. Also included are small areas of Epoufette soils that are dominantly gravel in the lower layers.

Most areas of Tobico loamy fine sand are wooded or are idle. This soil is moderately well suited to poorly suited to crops. Yields of all crops except sugarbeets are moderate if this soil is well managed. Wetness, low fertility, difficulty of draining, and the hazard of wind erosion are the main problems. This soil is poorly suited to trees. The high water table severely limits use of the areas for building sites or for intensive recreation.

Soil management unit 5c (IVw); woodland suitability group Q.

Tobico sandy loam (Tg).—This nearly level soil has a surface layer of sandy loam or mucky sandy loam to a depth of 1 foot or less. Below this is loose sand and gravel. Slopes are more than 2 percent on a few very low sand ridges.

Included with this soil are small areas of Roscommon soils that are limy to a depth of more than 10 inches. Also included are Epoufette soils that are dominantly gravel in the lower layers.

Most areas of Tobico sandy loam are wooded or idle. This soil is moderately well suited to poorly suited to crops. Yields of all crops except sugarbeets are moderate if this soil is well managed. Wetness, low fertility, difficulty of draining, and the hazard of wind erosion are the main problems. This soil is poorly suited to trees. The high water table severely limits use of the areas for building sites or for intensive recreation.

Soil management unit 5c (IVw); woodland suitability group Q.

Tonkey Series

The Tonkey soils are dark colored and poorly drained to very poorly drained. They formed in outwash deposits that were stratified and moderately sandy. The original vegetation was swamp hardwoods, willows, swamp grasses, and sedges.

Representative profile of Tonkey sandy loam in a cultivated field:

0 to 8 inches, black, very friable sandy loam; high in organic matter.
8 to 14 inches, grayish-brown, very friable sandy loam.
14 to 28 inches, pale-brown, friable loam mottled with strong brown and brownish yellow.
28 to 42 inches +, gray, very friable, limy sandy loam and loamy sand in thin layers.

The surface layer ranges from loamy sand to loam. In some wet, undisturbed areas a layer of black muck 2 to 12 inches thick is on the surface. The fourth layer is made up of a number of thin layers, each of which has a different texture than the one above and below. Sandy loam and loamy sand are dominant in the fourth layer but sand, gravel, loam, and silt occur in a few places. Colors below a depth of 8 inches range from brightly mottled to solid dull gray. The soils are limy within

30 inches of the surface, and many areas are limy to the surface.

Permeability of these soils is moderately rapid. Runoff is very slow to ponded.

Tonkey loam (Th).—This soil is in nearly level to depressional areas. The surface layer is generally loam, but it is very fine sandy loam or sandy loam in small areas. In a few places layers of clay loam to clay are at a depth of 3 to 4 feet. A few wet areas have as much as 12 inches of muck on the surface. In a few areas slopes are more than 2 percent.

Included with this soil are the somewhat poorly drained Richter soils in a few small areas. Also included are some soils that are dominantly coarse sand and gravel in the lower layers. Small included areas of Bruce soils are dominantly very fine sand and silt in the lower layers.

Most areas of Tonkey loam are wooded, but a few areas have been drained and are in crops or pasture. This soil is moderately well suited to crops. Yields of corn, oats, wheat, field beans, sugarbeets, and hay are moderately high. Wetness and the difficulty of maintaining a drainage system in some areas are the main problems. This soil is poorly suited to trees. The high water table severely limits use of the areas for building sites and for intensive recreational development.

Soil management unit 3c (IIw); woodland suitability group W.

Tonkey loamy sand (Tk).—This soil is in nearly level to depressional areas. The surface layer generally is loamy sand, but it is sandy loam or loamy fine sand in small areas. In a few places layers of clay loam to clay are at a depth of 3 to 4 feet. A few wet areas have as much as 12 inches of muck on the surface. Slopes are more than 2 percent in a few areas.

Included with this soil are somewhat poorly drained Richter soils in a few small areas. Also included are some soils that are dominantly coarse sand and gravel in the lower layers.

Most areas of Tonkey loamy sand are wooded, but a few areas are drained and used for crops or pasture. This soil is moderately well suited to most crops, and yields of the crops commonly grown are moderately high to moderate. Sugarbeets are not suited. Wetness, wind erosion, and the difficulty of maintaining a drainage system are the main problems. This soil is poorly suited to trees. The high water table severely limits use of the areas for building sites or for intensive recreational development.

Soil management unit 3c (IIw); woodland suitability group W.

Tonkey sandy loam (Tm).—This soil is in nearly level to depressional areas. The surface layer generally is sandy loam, but it is loamy sand or fine sandy loam in small areas. In a few places layers of clay loam to clay are at a depth of 3 to 4 feet. A few wet areas have as much as 12 inches of muck on the surface. Slopes are more than 2 percent in a few areas.

Included with this soil are somewhat poorly drained Richter soils in a few small areas. Also included are small areas that are dominantly coarse sand and gravel in the lower layers.

Most areas of this mapping unit are wooded, but a few areas are drained and used for crops or pasture. This soil is moderately well suited to crops. Yields of corn, oats, wheat, field beans, sugarbeets, and hay are moderately high. Wetness and the difficulty of maintaining a drainage system in places are the main problems. This soil is poorly suited to trees. The high water table severely limits use of the areas for building sites and for intensive recreation.

Soil management unit 3c (IIw); woodland suitability group W.

Twining Series

The Twining series consists of moderately dark colored, somewhat poorly drained soils. These soils formed in loamy glacial till. The original vegetation was stands of northern hardwoods. The areas are suited to farming if artificially drained (fig. 8).

Representative profile of Twining sandy loam in a cultivated field:

0 to 7 inches, very dark grayish-brown, friable sandy loam.
7 to 13 inches, yellowish-brown, very friable sandy loam.
13 to 16 inches, pale-brown, friable sandy loam mottled with yellowish brown and dark yellowish brown.
16 to 30 inches, brown, firm clay loam mottled with light brownish gray and dark brown.
30 to 42 inches +, light-brown, firm, limy clay loam strongly mottled with light brownish gray.

The surface layer of these soils is loamy sand, sandy loam, or loam. In undisturbed areas the surface layer is dark grayish brown and the layer just below is light brownish gray. In cultivated areas plowing has mixed part or all of the second layer with the original surface layer to form the present surface layer. The third layer is very thin in some places. Below are two layers of clay loam to sandy clay loam. The last of these is limy and is coarser textured than the other. Depth to limy material ranges from 25 to 40 inches. Slopes range from 0 to 6 percent but are dominantly from 0 to 2 percent. Permeability is moderately slow.

Twining loam, 0 to 2 percent slopes (TnA).—This nearly level soil is mainly on till plains. The surface layer is loam, but the second and third layers are loam or sandy loam and generally are very thin. The combined thickness of the first three layers is generally not more than 12 inches.

Included with this soil in mapping are dark-colored, poorly drained Sims soils in depressions and along minor natural drainageways. Also included are a few small areas of Isabella soils, which are on the tops of knolls and ridges where slopes range from 2 to 6 percent.

Most areas of this Twining soil are used for crops, and a few of the areas have been artificially drained. This soil is well suited to the crops commonly grown, and yields are high. Wetness is the main hazard. The soil is moderately well suited to trees. The seasonal high water table and moderately fine texture of this soil somewhat limit its use for building sites and for intensive recreational development.

Soil management unit 1.5b (IIw); woodland suitability group Z.

Twining-Belding loamy sands, 0 to 2 percent slopes (TsA).—In this complex are nearly level, sandy soils on till plains. The surface layer is loamy sand or loamy fine sand, but in a few areas it is sandy loam. In most places the soils have such texture to a depth of 6 to 24 inches, but in small areas the texture is the same to a greater depth. The Twining part of the complex is

Figure 8.—Hayfield and farm buildings on the Twining soils. These soils are suited to many crops if artificially drained.

generally larger than the Belding part, but in some local areas the Belding part is larger.

Included in this complex are dark-colored Sims soils in depressions and in small natural drainageways. Also included are Isabella and Ubly soils on the upper parts of knolls and ridges, where the slopes are generally slightly more than 2 percent.

Most areas of this complex are used for crops or pasture. The soils are moderately well suited to crops. All of the common crops can be grown, and yields are moderate to moderately high. Yields vary from field to field, depending on the soils that make up the particular field. Wetness, wind erosion, and variability in kinds of soils are the major problems. The soils of this complex are moderately well suited to trees. Their use for building sites or for intensive recreational development is moderately limited.

Soil management unit 1.5b (IIw); woodland suitability group Z.

Twining-Belding loamy sands, 2 to 6 percent slopes (TsB).—The soils in this complex are gently sloping and sandy. They are on knolls and ridges on till plains. Drainage is slightly better than in similar soils in more nearly level areas. The texture of the surface layer is dominantly loamy sand and loamy fine sand, but in a few small areas it is sandy loam. The sandy material ranges from 6 to 24 inches in thickness, but in a few spots the underlying clay loam is within plow depth. The Twining part is generally larger than the Belding part, but in some local areas the Belding part is larger. Slopes are dominantly between 2 and 6 percent but are outside these limits in small areas.

In depressions and along minor natural drainageways are Sims soils, which are darker colored than Twining and Belding soils. Some small areas are occupied by Isabella soils.

Most areas of this complex are in crops, and the soils are moderately well suited to crops. Yields of grain crops, beans, and hay are moderate, but those of sugarbeets are low to moderate. Because of the variability in the kinds of soils in a particular field, yields vary from field to field. In areas where the proportion of Belding or Isabella soils make up a larger part of an area than the Twining soils, yields are lower. Wetness, wind erosion, water erosion, and variability in the kinds of soils are the major problems. The soils are moderately well suited to trees. Limitations to use of the soils for building sites or for intensive recreational development are moderate.

Soil management unit 1.5b (IIw); woodland suitability group Z.

Twining-Belding sandy loams, 0 to 2 percent slopes (TwA).—The soils in this complex are on nearly level till plains and in level to depressional areas on moraines. The surface layer is sandy loam or fine sandy loam, but in a few areas it is loam or loamy sand. It is generally less than 30 inches thick, but in a few areas it is thicker. The second and third layers are sandy loam or loamy sand in texture. The Twining part of this complex is generally larger than the Belding part, but in some local areas the Belding part is larger. Slopes are more than 2 percent in a few places.

Included in this complex are Sims soils in small depressions and along minor natural drainageways. These soils are darker colored than other soils in the complex and have a surface layer of loam. Also included are Isabella and Ubly soils on the tops of some of the knolls.

Areas of this complex are used largely for crops and improved pasture. A few areas have been artificially drained. The soils are moderately well suited to crops. All of the common crops can be grown, and yields are moderately high. The major problems are wetness, wind erosion, and variability in the kinds of soils that make up a particular field. The soils are moderately well suited to trees. Limitations to use of the areas for building sites or for intensive recreational development are moderate.

Soil management unit 1.5b (IIw); woodland suitability group Z.

Twining-Belding sandy loams, 2 to 6 percent slopes (TwB).—The soils in this complex are gently sloping and therefore have slightly better drainage than similar soils in level areas. The areas are small and are on the lower slopes of morainic hills and on gently undulating till plains.

The surface layer is mostly sandy loam or fine sandy loam, but it is loamy sand or is loam in a few areas. The texture of the second and third layers is loamy sand or sandy loam. In a few areas the sandy material is more than 18 inches thick. The Twining part of this complex is generally larger than the Belding part, but in some local areas the Belding part is larger. Slopes are dominantly between 2 and 6 percent, but they range outside these limits in small areas.

Included in this complex are dark-colored Sims soils in closed depressions and small natural drainageways. Also included are Isabella and Ubly soils on the higher parts of some small knolls and ridges.

Most areas of this complex are in crops or pasture. The soils are moderately well suited to crops, and yields of the common crops are moderate to moderately high. Wetness, wind and water erosion, and variability in the kinds of soils in a particular field are the main problems. The soils are moderately well suited to trees. Limitations to use of the areas for building sites or for intensive recreational development are moderate.

Soil management unit 1.5b (IIw); woodland suitability group Z.

Ubly Series

Soils of the Ubly series are light colored and well drained to moderately well drained. They formed in 18 to 42 inches of loamy fine sand to fine sandy loam and are underlain by loam to clay loam. The original vegetation was northern hardwoods and white pines.

Representative profile of Ubly fine sandy loam in a cultivated field:

0 to 8 inches, very dark grayish brown, friable fine sandy loam.
8 to 15 inches, dark-brown, friable sandy loam.
15 to 20 inches, pale-brown, friable sandy loam.
20 to 32 inches, dark-brown, firm clay loam.
32 to 42 inches +, brown, firm clay loam.

In some undisturbed areas the surface layer is somewhat thinner than described and a thin gray layer is between it and the second layer. The sandy material in the upper part of the profile ranges from 18 to 30 inches in thickness, but in a few places it is as much as 42 inches thick. The third layer is very thin in some places and is difficult to distinguish. Reaction is medium acid to slightly acid in the upper three layers and slightly acid to neutral in the fourth layer.

Permeability of these soils is moderately rapid in the upper part and moderately slow in the lower part. Runoff is slow on the milder slopes and rapid on the steep.

In this county Ubly soils occur closely with the Isabella soils and are mapped only in complexes with those soils. A representative profile of the Isabella soils is described under the Isabella series.

Wainola Series

In the Wainola series are moderately dark colored, somewhat poorly drained soils. These soils formed in deposits of outwash made up of thin layers of different sizes of sand and loamy sand. The original vegetation was a mixture of upland and lowland hardwoods that included some white-cedars.

Representative profile of Wainola loamy fine sand in a wooded area:

0 to 2 inches, black, very friable loamy fine sand.
2 to 10 inches, pinkish-gray, very friable loamy fine sand.
10 to 14 inches, brown, very friable loamy fine sand mottled with light brown and dark brown.
14 to 25 inches, yellowish-brown, very friable very fine sand mottled in places with pale brown and reddish yellow.
25 to 42 inches +, thin layers of dark yellowish-brown and pale-brown, very friable fine sand and loamy sand; has mottles of strong brown, reddish yellow, and light brown.

In cultivated areas plowing has mixed material from the upper part of the second layer with the first layer to form a very dark grayish-brown plow layer. In a few areas the third layer contains firmly cemented chunks of material. The order and thickness of the layers of fine sand and loamy fine sand vary considerably within a short distance. Layers of medium and coarse sand and gravel also occur in many areas, and in a few areas thin layers of silty and clayey material occur. The amount and color of mottling both vary considerably. Reaction of the upper three layers is strongly acid to medium acid, and that of the fourth layer is slightly acid to neutral. Limy material is at a depth of more than 3 feet in places.

Permeability of these soils is rapid. Runoff is slow.

Wainola loamy fine sand, 0 to 2 percent slopes (WaA).—This nearly level soil is on outwash plains. The surface layer is dominantly loamy fine sand, but it is fine sand or fine sandy loam in a few areas. Slopes are more than 2 percent in a few small areas.

Included with this soil in mapping are Deford soils, in depressions and minor natural drainageways, and Rousseau soils, on some small knolls and ridges. Also included are Au Gres soils, in areas where the sandy outwash is underlain by loamy or clayey material at a depth of less than 66 inches.

Areas of this Wainola soil are used mainly for crops and pasture. The soil is moderately well suited to poorly suited to crops. Yields of most common crops are moderate, but those of sugarbeets are moderate to low. Wetness, droughtiness, and wind erosion are the major problems. This soil is moderately well suited to trees. Because of the seasonal high water table, limitations to use of this soil for building sites and for intensive recreational development are moderate.

Soil management unit 4b (IIIw); woodland suitability group F.

Wainola loamy fine sand, 2 to 6 percent slopes (WaB).—Areas of this soil are generally on low ridges on lake and outwash plains. The soil is gently sloping and therefore has slightly better drainage than soils that are similar but nearly level. The surface layer is dominantly loamy fine sand but is fine sand or fine sandy loam in a few places. Slopes are dominantly between 2 and 6 percent, but they range beyond these limits in small areas. In a few places the present plow layer includes material from the original third layer.

Included with this soil in mapping are small areas of Deford soils, on some of the lower slopes, and Rousseau soils, in some higher lying areas. Also included are somewhat poorly drained Au Gres soils, in areas where the sandy material is underlain by loamy or clayey material at a depth of less than 60 inches.

Much of this Wainola soil is in crops and pasture. This soil is moderately well suited to poorly suited to crops. Yields of grain and hay are moderate, and yields of beans and sugarbeets are low. Wetness, droughtiness, and wind erosion are the main problems. This soil is moderately well suited to trees. Because of the seasonal high water table, use of the areas for building sites and intensive recreational development are moderately limited.

Soil management unit 4b (IIIw); woodland suitability group F.

Warners Series

In the Warners series are organic soils underlain by marl at a depth of less than 12 inches. These soils have a high water table. The original vegetation was elm, soft maple, willow, and sedges. Most areas are now in crops.

Representative profile of Warners muck:

0 to 8 inches, very dark grayish-brown, friable muck.
8 to 20 inches +, light-gray, friable marl.

In places the muck is lacking and marl is exposed. The marl includes thin layers of organic material in places.

Permeability of these soils ranges from moderate to moderately slow, depending on compactness of the marl. Runoff is very slow to ponded.

Warners muck and marl (Wk).—This is the only Warners soil mapped in the county. It is in nearly level to depressional areas. In places marl is exposed by plowing.

All areas of this mapping unit are cleared and drained and are now in crops or formerly were in crops. This soil is poorly suited to crops or is not suited. Because of the variability of the marl, the effectiveness of artificial drainage varies. The marl also is likely to be deficient in minor elements. Wetness and fertility are the main problems. This soil is poorly suited to trees. The high water table and instability of the marl severely limit use of the areas for building sites or for intensive recreational development.

Soil management unit M/mc (IVw); woodland suitability group J.

Willette Series

Soils of the Willette series are very dark colored and very poorly drained. These soils consist of muck or peat that is underlain by clayey material at a depth of 12 to 42 inches. The original vegetation was chiefly elm, ash, and soft maple.

Representative profile of Willette muck in a wooded area:

0 to 8 inches, very dark brown, friable muck.
8 to 15 inches, very dark brown, friable muck; contains many partly decomposed wood fragments.
15 to 30 inches, dark-brown, fibrous peat; contains many pieces of partly decomposed wood.
30 to 92 inches +, light-gray, firm, limy clay.

The first three organic layers are from plant remains, but the fourth layer is mineral material. In color the first layer ranges to black. The organic layers consist of a variable number of layers of black, granular muck and brown, fibrous peat or of mixtures of the two. Bits of unrotted wood and a few logs are scattered throughout the organic layers. The fourth layer is heavy silty clay loam, heavy clay loam, silty clay, or clay. These soils are moderately acid to neutral. Slopes range from 0 to 2 percent.

Permeability is moderate in the organic material of these soils and very slow in the mineral material. Runoff is very slow to ponded.

Willette muck (Wm).—This is the only Willette soil mapped in the county. It is in nearly level to depressional areas. The surface layer is sometimes muck or peat, but it generally is a mixture of the two. In a few small areas, the material is alkaline.

Included with this soil are small areas of Carbondale soils that consist of more than 42 inches of organic material. Also included are soils that are clayey within 12 inches of the surface. Other small included areas consist of Linwood soils, in which the lowest layer is moderately fine textured rather than fine textured.

Most areas of this Willette soil are wooded. This soil is moderately well suited to corn if the location is in an area not subject to frost during the growing season. It is well suited to sugarbeets and to truck crops. Wetness and wind erosion are the main problems. Because of the thinness of the organic layer, care is needed to keep from destroying the organic material. This soil is poorly suited to trees. The high water table and instability of the soil material severely limit use of the areas for building sites or for intensive recreational development.

Soil management M/lc (IIIw); woodland suitability group J.

Wisner Series

In the Wisner series are dark-colored, poorly drained to very poorly drained, limy soils. These soils formed in moderately fine textured glacial till. The original vegetation was lowland forests and reeds and sedges.

Representative profile of Wisner clay loam in a cultivated field:

0 to 8 inches, black, limy, firm clay loam; granular structure.
8 to 18 inches, gray, limy, firm clay loam mottled with brown.
18 inches +, grayish-brown, limy, firm clay loam mottled with gray, pale brown, and yellowish brown.

In undisturbed areas a layer of muck 1 to 10 inches thick is on the surface. The surface layer is clay loam,

loam, and sandy loam. In some areas the black surface layer is thicker than the depth of plowing. Thin layers of loam and sandy loam are in the third layer. Slopes are 0 to 2 percent.

Permeability of these soils is moderately slow. Runoff is very slow to ponded.

The Wisner soils are productive if adequate drainage is provided. Most areas are in crops.

Wisner clay loam (Wn).—This soil is generally clay loam throughout, but in small areas the surface layer is loam, sandy clay loam, or silty clay loam. In places a few thin layers of sandy material are in the third layer.

Included with this soil are small areas of Sims soils, in which limy material is more than 18 inches thick. On a few, small, gently sloping knolls are the somewhat poorly drained Kawkawlin or Twining soils.

Wisner clay loam is mostly in crops, to which it is well suited. Yields of the crops commonly grown are high if the soil is well managed. Wetness and lack of minor elements are the main problems. This soil is poorly suited to trees. The high water table and fine texture of the soil severely limit use of the areas for building sites or for intensive recreation.

Soil management unit 1.5c (IIw); woodland suitability group P.

Wisner loam (Wo).—This soil is underlain by clay loam at a depth of 18 inches or less. In small areas the surface layer is sandy loam, sandy clay loam, or clay loam. In places a few thin layers of sandy material are in the third layer.

Included with this soil are small areas of Sims soils that consist of limy material to a depth of more than 18 inches. On a few, small, gently sloping knolls are the somewhat poorly drained Kawkawlin or Twining soils.

Wisner loam is mostly in crops, to which it is well suited. Yields of the crops commonly grown are high if the soil is well managed. Wetness and lack of minor elements are the main problems. This soil is poorly suited to trees. The high water table and fine texture of the soil severely limit use of the areas for building sites or for intensive recreational development.

Soil management unit 1.5c (IIw); woodland suitability group P.

Wisner sandy loam (Ws).—This soil is sandy loam to a depth of 6 to 18 inches. Below, the texture is clay loam. A few thin layers of sandy material are in the third layer in some areas. In large areas the surface layer is loam. Overwash of sand or loamy sand is on a few areas along minor natural drainageways.

Included with this soil are small areas of Sims soils that are more than 18 inches thick to lime. On a few, small, gently sloping knolls are the somewhat poorly drained Kawkawlin and Twining soils.

Wisner sandy loam is mostly in crops, to which it is well suited. Yields of all crops commonly grown are high if the soil is well managed. Wetness and lack of minor elements are the main problems. This soil is poorly suited to trees. The high water table and fine texture of the soil severely limit use of the areas for building sites or for intensive recreation.

Soil management unit 1.5c (IIw); woodland suitability group P.

Use and Management of the Soils

In this section the capability groupings used by the Soil Conservation Service are explained and a list of the soil management groups and units is given. Then the soil management units are discussed in detail and suggestions about use of the soils and practices needed are given. Next, predicted yields of the principal crops are listed. Finally information about use of the soils for woodland, wildlife, and engineering purposes is given.

Capability Groups of Soils

The capability classification is a grouping that shows, in a general way, how suitable soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony, and *c*, used in only some parts of the country, indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it have little or no erosion hazard but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, which are also referred to as soil management units. A capability unit is made up of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus the capability unit, or management unit, is a convenient grouping for making many statements about the management of soils. Soil management units, as they are called in this report, are generally identified by symbols assigned locally, such as 1.5aA, 3aA, and 5/2b, combined with the capability classes and subclasses, such as IIs, IIIs, and IIIw.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their

permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

The eight classes in the capability system, and the subclasses and soil management units in this county are described in the list that follows.

Class I. Soils that have few limitations that restrict their use. (None in this county.)

Class II. Soils that have some limitations that reduce the choice of plants or that require moderate conservation practices.

Subclass IIe. Soils subject to moderate erosion if they are not protected.

Unit 1.5aB (IIe). Gently sloping, well drained or moderately well drained sandy and loamy soils that have a subsoil of loamy sand to sandy loam or clay loam.

Subclass IIw. Soils that have moderate limitations because of excess water.

Unit 1.5b (IIw). Nearly level to gently sloping, somewhat poorly drained sandy and loamy soils that have a moderately fine textured subsoil.

Unit 1.5c (IIw). Nearly level, very poorly drained sandy and loamy soils that have a moderately fine textured subsoil.

Unit 3b (IIw). Nearly level to gently sloping, somewhat poorly drained sandy and loamy soils that have a medium textured to moderately coarse textured subsoil.

Unit 3 c (IIw). Nearly level, very poorly drained, loamy and sandy soils that have a subsoil of sandy loam.

Subclass IIs. Soils that have moderate limitations because of moisture capacity, rooting zone, or other soil features.

Unit 1.5aA (IIs). Nearly level, well drained or moderately well drained loamy sands and sandy loams that have a subsoil of loamy sand to sandy loam or clay loam.

Unit 3aA (IIs). Chiefly nearly level, well drained and moderately well drained loamy fine sands and very fine sandy loams that have a subsoil of medium texture.

Class III. Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.

Unit 1aB (IIIe). Gently sloping, well drained to moderately well drained loams that have a clayey subsoil.

Unit 1aC (IIIe). Moderately sloping, well drained to moderately well drained loams that have a clayey subsoil.

Unit 1.5aB2 (IIIe). Gently sloping, well drained or moderately well drained, moderately eroded sandy loams that have a subsoil of loamy sand to sandy loam or clay loam.

Unit 1.5aC (IIIe). Moderately sloping, well drained or moderately well drained loamy and sandy soils that have a subsoil of loamy sand to sandy loam or clay loam.

Unit 1.5aC2 (IIIe). Moderately sloping, well drained or moderately well drained, moderately eroded sandy loams that have a subsoil of loamy sand to sandy loam or clay loam.

Unit 4/2aC (IIIe). Moderately sloping, well drained or moderately well drained, sandy soils underlain by loam to clay loam at a depth of 18 to 42 inches.

Subclass IIIw. Soils that have severe limitations because of excess water.

Unit 1b (IIIw). Nearly level to gently sloping, somewhat poorly drained soils that have a sandy or loamy surface soil and a clayey subsoil.

Unit 1c (IIIw). Nearly level, poorly drained and very poorly drained soils that have a loamy, sandy, or clayey surface soil and a clayey subsoil.

Unit 4b (IIIw). Nearly level to gently sloping, somewhat poorly drained sandy soils that have a subsoil of loamy sand.

Unit 4c (IIIw). Nearly level, poorly drained and very poorly drained sandy and loamy soils that have a moderately coarse textured subsoil.

Unit 4/1b (IIIw). Nearly level to gently sloping, somewhat poorly drained loamy sands underlain by clay at a depth of 18 to 42 inches.

Unit 4/1c (IIIw). Nearly level, poorly drained and very poorly drained soils that are underlain by clay at a depth of 18 to 42 inches.

Unit 4/2b (IIIw). Nearly level to gently sloping, somewhat poorly drained sandy soils underlain by loam to clay loam at a depth of 18 to 42 inches.

Unit 4/2c (IIIw). Nearly level, poorly drained and very poorly drained sandy or loamy soils underlain by clay loam at a depth of 18 to 42 inches.

Unit 5/2b (IIIw). Nearly level to gently sloping, somewhat poorly drained sands underlain by loam to clay at a depth of 42 to 66 inches.

Unit Mc (IIIw). Nearly level, very poorly drained, deep organic soils.

Unit M/1c (IIIw). Nearly level organic soils underlain by silty clay or clay at a depth of 12 to 42 inches.

Unit M/3c (IIIw). Nearly level organic soils underlain by clay loam at a depth of 12 to 42 inches.

Subclass IIIs. Soils that have severe limitations of moisture capacity or rooting zone.

Unit 1aA (IIIs). Nearly level, well drained or moderately well drained loamy soils that have a clayey subsoil.

Unit 4aA (IIIs). Nearly level, well drained or moderately well drained sandy soils that have a moderately coarse textured subsoil.

Unit 4aBC (IIIs). Gently sloping, well-drained sands that have a moderately coarse textured subsoil.

Unit 4/2aA (IIIs). Nearly level, well drained or moderately well drained sandy soils underlain by loam to clay loam at a depth of 18 to 42 inches.

Unit 4/2aB (IIIs). Gently sloping, well drained or moderately well drained sandy soils underlain by loam to clay loam at a depth of 18 to 42 inches.

Unit 5/2aAB (IIIs). Nearly level to gently sloping, well-drained sandy soils underlain by loam to clay at a depth of 42 to 66 inches.

Class IV. Soils that have very severe limitations that restrict the choice of plants, that require very careful management, or both.

Subclass IVe. Soils subject to very severe erosion if they are cultivated and not protected.

Unit 1.5aD (IVe). Strongly sloping, well drained or moderately well drained loamy sands and sandy loams that have a subsoil of loamy sand to sandy loam or clay loam.

Unit 4/2aD (IVe). Chiefly strongly sloping, well drained or moderately well drained sandy soils underlain by loam to clay loam at a depth of 18 to 42 inches.

Unit 5/2aC (IVe). Chiefly moderately sloping, well drained or moderately well drained sandy soils underlain by loam to clay at a depth of 42 to 66 inches.

Subclass IVw. Soils that have very severe limitations for cultivation because of excess water.

Unit 5b (IVw). Nearly level to gently sloping, somewhat poorly drained sandy soils.

Unit 5c (IVw). Chiefly nearly level, poorly drained or very poorly drained sandy and loamy soils that have a coarse-textured subsoil.

Unit M/4c (IVw). Nearly level organic soils underlain by sand or loamy sand at a depth of 12 to 42 inches.

Unit M/mc (IVw). Nearly level organic soils underlain by marl at a depth of less than 42 inches.

Subclass IVs. Soils that have very severe limitations of moisture capacity or rooting zone.

Unit 4/RaABC (IVs). Nearly level to moderately sloping, well drained or moderately well drained loamy sands underlain by bedrock at a depth of 18 to 42 inches.

Class V. Soils not likely to erode but that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture, woodland, or wildlife food and cover.

Subclass Vw. Soils too wet for cultivation; drainage or protection not feasible.

Unit Lc (Vw). Nearly level, somewhat poorly drained or poorly drained soil material that is coarse textured to fine textured and is along streams.

Class VI. Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture, woodland, or wildlife food and cover.

Subclass VIe. Soils severely limited, chiefly by risk of erosion, if protective cover is not maintained.

Unit 1.5aCD3 (VIe). Moderately sloping and strongly sloping, well drained or moderately well drained clay loams that are severely eroded.

Unit 1.5aE (VIe). Hilly, well drained or moderately well drained fine sandy loams that have a subsoil of clay loam.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIe. Soils very severely limited, chiefly by risk of erosion, if protective cover is not maintained.

Unit 1.5aEF3 (VIIe). Hilly to steep, well drained or moderately well drained clay loams that are severely eroded or gullied.

Unit 1.5aF (VIIe). Steep, well drained or moderately well drained loamy sands and sandy loams that have a subsoil of loamy sand to sandy loam or clay loam.

Subclass VIIw. Soils very severely limited by excess water and other soil features.

Unit 5b–h (VIIw). Nearly level, somewhat poorly drained sandy soils that have a hardpan.

Subclass VIIs. Soils very severely limited by moisture-supplying capacity, stones, or other soil features.

Unit 5.3aCF (VIIs). Chiefly moderately sloping to steep, well drained or moderately well drained sandy soils.

Unit 5.7aAC (VIIs). Nearly level to moderately steep, well-drained sandy soils.

Unit RaAB (VIIs). Nearly level to gently sloping, well-drained soils underlain by limestone bedrock at a depth of less than 18 inches.

Class VIII. Soils and landforms that, without major reclamation, have limitations that preclude their use for commercial production of plants and restrict their use to recreation, wildlife, water supply, or esthetic purposes.

Subclass VIIIw. Extremely wet or marshy land.

Unit Mc–a (VIIIw). Nearly level, very poorly drained, extremely acid, raw, organic soils.

Unit Sc (VIIIw). Nearly level, very poorly drained marshland adjacent to lakes.

Subclass VIIIs. Gravelly or stony materials that have little potential for production of plants.

Unit Sa (VIIIs). Well-drained soils on coastal beaches along Lake Huron.

Soil Management Groups and Units

Each soil that has been named differs from all other soils in one or more important characteristics. We need to consider each of the soils individually in making exact statements about how to use and take care of the soils.

Many useful statements, however, can be made about groups of soils that are similar in texture and other properties throughout their profiles and have similar drainage. These groupings, called soil management groups, are useful for making general suggestions about management. They are also useful for making general suggestions for plantings in woodland and for designs for irrigation or drainage systems.

For the purpose of making more specific statements concerning cropping systems and conservation practices, soil management groups are further subdivided into soil management units, also called capability units, according to significant variations in slope and in degree of erosion.

Table 2 shows that each soil management group is designated by a symbol that shows the position of the soil on the landscape, the texture of significant layers in the profile that greatly affects soil management, and the degree of natural internal drainage. In this table the mineral soils are arranged vertically, from the finest textures at the top to the coarsest textures at the bottom. They are also arranged horizontally from the best drained at the left to the most poorly drained at the right. For example, soils in soil management groups 4a are upland soils. The "4" in the symbol shows that the soils formed in loamy sand, and the "a" shows that the soils are well drained or moderately well drained. The symbol 5b, on the other hand, stands for sand that is somewhat poorly drained, as indicated by the letter b; and 5b-h stands for somewhat poorly drained sand that contains a hardpan.

The capital letter L in a symbol indicates that soils are on lowlands and are subject to flooding. The letter M stands for organic soils (*2*),[8] either muck or peat. The symbol Mc, for example, stands for poorly drained or very poorly drained, organic material more than 42 inches thick and Mc-a for material that is similar to that represented by the symbol Mc but is very strongly acid.

Where soils are formed from one kind of soil material on top of another kind of soil material, a fractional type of symbol is used. The number or letter above the diagonal line refers to the upper layer, and the number or letter below the line refers to the lower layer. For example, 4/2 stands for sand or sandy loam 18 to 42 inches thick over loam to clay loam. M/mc stands for organic material less than 42 inches thick over marl; its natural drainage is poor or very poor, as shown by the letter c.

Soil management groups are subdivided according to significant ranges of slope and degree of erosion into soil management units, also called capability units. In general, the capital letter A, B, C, D, E, or F, placed after the management group symbol, designates the range of slope. The A in soil management unit 4aA, for example, means that the soils are nearly level. Other slope designations are B for gently sloping, C for moderately sloping, D for strongly sloping, E for hilly, and F for steep. All slope groups are shown in the symbol, unless they repre-

[8] Italic numbers in parentheses refer to Literature Cited, p. 142.

TABLE 2.—*Relationships of soil management groups*

Position of soil and texture of parent material	Natural drainage		
	Well drained or moderately well drained (a)	Somewhat poorly drained (b)	Poorly drained or very poorly drained (c)
Upland soils:			
1—Silty clay or clay	1a	1b	1c.
1.5—Clay loam or silty clay loam.	1.5a	1.5b	1.5c.
3—Sandy loam	3a	3b	3c.
4—Loamy sand	4a	4b	4c.
4/1—Sand or loamy sand 18 to 42 inches thick over clay to silty clay.		4/1b	4/1c.
4/2—Sand or loamy sand 18 to 42 inches thick over loam to clay loam.	4/2a	4/2b	4/2c.
4/Ra—Sand or loamy sand 18 to 42 inches thick over bedrock.	4/Ra.		
5—Sand		5b, 5b–h	5c.
5.3—Sand, very droughty.	5.3a.		
5/2—Sand or loamy sand 42 to 66 inches thick over loam to clay.	5/2a	5/2b.	
5.7—Coarse sand	5.7a.		
R—Less than 18 inches thick over bedrock.	Ra.		
Lowland soils:			
L—Soils of variable texture along streams.		Lc	Lc.
Organic soils, M:			
M—More than 42 inches thick.			Mc, Mc–a.
M/1—Organic material 12 to 42 inches thick over clay or silty clay.			M/1c.
M/3—Organic material 12 to 42 inches thick over clay loam.			M/3c.
M/4—Organic material 12 to 42 inches thick over sand or loamy sand.			M/4c.
M/m—Organic material less than 42 inches thick over marl.			M/mc.
Miscellaneous land types:			
S—Lake beach and Fresh water marsh.	Sa		Sc.

sent less than 10 percent of the total acreage of the soil management unit. Dual capital letters, for example BC in the soil management unit 4aBC, indicate the soils are gently sloping to moderately sloping. The numerical range in slope gradient of the slope groups are—

	Percent slopes
A	0 to 2
B	2 to 6
C	6 to 12
D	12 to 18
E	18 to 25
F	25 to 55+

In some soil management unit symbols, the number 3 follows the slope group letter and indicates that all or nearly all of the soils in the unit are severely eroded. If the number 2 follows the slope group letter, it indicates that the soils are moderately eroded. Absence of the number 2 or 3 indicates the soils are slightly eroded or moderately eroded.

Management by Soil Management Units

In the pages that follow, each soil management unit is described, according to the numerical and alphabetical order shown in table 2. The soils in each unit are listed, and management suitable for all the soils in a unit is suggested.

The soils in each soil management unit have about the same limitations and similar risks of damage. All of the soils in one unit, therefore, need about the same kind of management, though they may have formed from different kinds of parent material and in different ways.

Additional help in managing the soils can be obtained by consulting the local representative of the Soil Conservation Service, the county agent, and the staff of the State Agricultural Experiment Station. They can provide technical help on land preparation, cropping systems, erosion control practices, practices needed to improve woodland, drainage, and other farm problems. Information on crop varieties, mixtures for seeding pastures, soil testing, and needs for fertilizer and lime (*3*, *5*) can be obtained from publications of the Michigan Agricultural Experiment Station.

Soil management unit 1aA (IIIs)

Only one soil, Kent loam, 0 to 2 percent slopes, is in this unit. It is a nearly level, well drained or moderately well drained soil that has a clayey subsoil.

This soil is well suited to the crops commonly grown in the county. The soil is fertile, but water moves slowly through it. As a result, the soil warms up slowly in spring and remains wet after a prolonged rain. Generally, moisture needed for growing plants is available. Permeability is slow and in places limits recharge of water during the growing season.

A row crop can be grown each year on this soil if all crop residues are returned and minimum tillage is used. Pastures are productive. The soil is suitable for the common forage crops and well suited to birdsfoot trefoil. Adding organic matter frequently and restricting grazing in spring and after wet periods help to maintain soil structure.

Soil management unit 1aB (IIIe)

The only soil in this unit is Kent loam, 2 to 6 percent slopes. This soil is gently sloping and is well drained to moderately well drained. It has a clayey subsoil.

This soil is moderately well suited to the crops commonly grown in the county. It is fertile, but water moves slowly through it. As a result, it is slow to warm up in spring and remains wet after a prolonged rain. Generally, moisture needed for growing plants is available. The soil is subject to water erosion.

Several combinations of cropping systems and conservation practices can be used safely. If no practices are used, a suitable cropping system is 1 year each of a row crop and small grain and 2 years of hay. Pastures on this soil are productive, and the soil is suitable for the forage crops commonly grown. This soil is well suited to birdsfoot trefoil. Adding organic matter frequently and restricting grazing in spring and after wet periods are ways to help maintain soil structure. Keeping waterways in grass helps to prevent erosion.

Soil management unit 1aC (IIIe)

Kent loam, 6 to 12 percent slopes, is the only soil in this unit. It is a moderately sloping, well drained to moderately well drained soil that has a clayey subsoil.

This soil is moderately well suited to most crops commonly grown in the county. Sugarbeets and beans, however, are not suitable. The soil is fertile, but water moves slowly through it. As a result this soil is slow to warm up in spring and remains wet after a prolonged rain. Moisture needed for growing plants is available. This soil is subject to severe water erosion if cultivated.

Several combinations of cropping systems and conservation practices can be used safely. In the sloping areas a suitable cropping system, if no practices are used, is 1 year each of a row crop and a small grain and 3 years of hay. Pastures on this soil are productive, and the soil is suitable for the forage crops commonly grown and is well suited to birdsfoot trefoil. Adding organic matter frequently and restricting grazing in spring and after wet periods help to maintain soil structure. Keeping waterways in grass helps to prevent erosion.

Soil management unit 1b (IIIw)

In this unit are nearly level to gently sloping, somewhat poorly drained soils that have a clayey subsoil. These soils are—

Rudyard silty clay loam, 0 to 2 percent slopes.
Selkirk fine sandy loam, 0 to 2 percent slopes.
Selkirk loam, 0 to 2 percent slopes.
Selkirk loam, 2 to 6 percent slopes.
Selkirk loamy sand, 0 to 2 percent slopes.
Selkirk silt loam, 0 to 2 percent slopes.
Selkirk silty clay loam, 0 to 2 percent slopes.

If these soils are drained, most of them are well suited to the crops commonly grown in the county. Selkirk loamy sand, 0 to 2 percent slopes, is only moderately well suited, however. These soils are fertile, but even when drained are slow to warm up in spring or after a prolonged wet period. They are slowly permeable, and their capacity to supply moisture to growing plants is high. The loamy sand and fine sandy loam are subject to wind erosion in places.

The soils in this unit are productive if artificially drained, and drainage can be provided by tile. These soils ought not to be cultivated when wet, tillage must be kept to a minimum, and if feasible, crops should be planted at the time of plowing or shortly after. Row crops can be grown each year if all crop residues are returned and minimum tillage is used, but less intensive cropping is necessary if customary tillage is used. The soils are well suited to pasture, but the kinds of forage plants grown depend on the degree of artificial drainage. Adding organic material frequently and restricting grazing during wet periods help to maintain soil structure.

Yields from woodland on these soils are moderate to low, and trees are seldom planted. If planting is done, use spruce seedlings and plant them on ridges. Trees grow better in areas that are artificially drained than in areas that are not drained.

Soil management unit 1c (IIIw)

The soils in this unit are nearly level, very poorly drained, and have a clayey subsoil. They are—

Bergland mucky loam.
Charity silty clay loam.
Pickford fine sandy loam.
Pickford loamy sand.
Pickford silty clay.
Pickford silty clay loam.

These soils are very poorly drained and must be artificially drained before they can be cropped. They are slowly and very slowly permeable and warm up slowly after wet periods. The moisture-supplying capacity is high.

All crops common to the county can be grown successfully on soils of this unit if the soils are drained. Drainage can be provided by tile. Low areas are subject to frost, even in summer. These soils ought not to be cultivated when wet, tillage must be kept to a minimum, and if feasible, crops should be planted at the time of plowing or shortly after. A suitable cropping system, if all residues are returned and minimum tillage is used, is 2 years of row crops with a cover crop in alternate years. Lime is seldom needed. The Charity soil is neutral to calcareous in the surface soil and generally is deficient in manganese. Minor elements may be needed for some crops on this soil. The soils in this unit are well suited to pasture, but the kinds of forage plants grown depend on the degree of artificial drainage. Grazing must be restricted during wet seasons.

Yields from woodland on these soils are low, and trees are seldom planted. If planting is done, use spruce seedlings and plant them on ridges. Trees on these soils are shallow rooted, and the hazard of windthrow is severe.

Soil management unit 1.5aA (IIs)

This unit consists of nearly level soils that are well drained or moderately well drained. The subsoil of these soils ranges from loamy sand to sandy loam or clay loam in texture. The soils in this unit are—

Isabella–Ubly loamy sands, 0 to 2 percent slopes.
Isabella–Ubly sandy loams, 0 to 2 percent slopes.
Nester fine sandy loam, 0 to 2 percent slopes.

These soils are well suited to moderately well suited to all crops commonly grown in the county. They are fertile and have the capacity to furnish moisture for growing crops.

Row crops can be grown each year on these soils if all residues are returned, minimum tillage is used, and a cover crop is seeded in alternate years. All other less intensive rotations also can be used. These soils ought not to be tilled when wet, and crops should be planted at the time of plowing or shortly after. The soils are well suited to pasture, and yields of all of the common forage crops are good. Adding organic material and restricting grazing in spring when the soils are wet are ways of maintaining soil structure and preventing soil packing.

These soils are well suited to trees, and yields are above the average for the county. Trees are seldom planted, however, because the soils are suitable for crops. If planting is done, use Norway spruce, white spruce, white pine, or Austrian pine.

Soil management unit 1.5aB (IIe)

Soils in this unit are gently sloping and are well drained or moderately well drained. The subsoil of these soils ranges from loamy sand to sandy loam or clay loam in texture. The soils in this unit are—

Isabella–Ubly loamy sands, 2 to 6 percent slopes.
Isabella–Ubly sandy loams, 2 to 6 percent slopes.
Nester fine sandy loam, 2 to 6 percent slopes.
Nester loam, 2 to 6 percent slopes.
Nester silty clay loam, 2 to 6 percent slopes.

These soils are well suited to moderately well suited to most crops commonly grown in the county. They are fertile and have the capacity to furnish moisture needed for growing crops. These soils are subject to erosion. Their content of organic matter is low.

A suitable cropping system for these soils, if no practices are used for the control of erosion, is 1 year each of a row crop, small grain, and meadow crop. Large amounts of fertilizer are needed, all residues must be returned, and tillage should be kept to a minimum. These soils are well suited to pasture. All common forage crops can be grown, and yields are high. Restricting grazing in spring and after wet periods helps to maintain soil structure.

These soils are well suited to trees, and yields are above average for the county. Trees are seldom planted, however, because the soils are suitable for crops. If planting is done, Norway spruce, white spruce, white pine, or Austrian pine are suitable for most areas. In exposed areas, plant Austrian pine or redcedar.

Soil management unit 1.5aB2 (IIIe)

In this unit are gently sloping soils that are well drained or moderately well drained. The subsoil of these soils ranges from loamy sand to sandy loam or clay loam in texture. The soils in this unit are—

Isabella–Ubly sandy loams, 2 to 6 percent slopes, moderately eroded.
Nester fine sandy loam, 2 to 6 percent slopes, moderately eroded.

Except for sugarbeets, most crops in the county are suitable for these soils. These soils are fertile, but their productivity has been reduced through erosion, to which the soils are highly susceptible. The content of organic matter is low, and organic material must be added.

These soils require more careful management than similar soils that are not eroded, and yields are lower. If no practices are used for the control of erosion, a suitable rotation is 1 year of a small grain followed by meadow crops. Row crops can be grown each year if terracing is done, all residues are returned, and minimum tillage is used. Pastures on these soils are productive if adequate fertilizer and lime are added. The common grasses and legumes grown for forage are suited to these soils, and birdsfoot trefoil is well suited. It is necessary to restrict grazing during wet periods.

Trees are not grown on most areas of these soils. If planting is done, use Austrian pine or redcedar. Growth of planted trees on these soils is good, and yields are satisfactory.

Soil management unit 1.5aC (IIIe)

In this unit are moderately sloping soils that are well drained or moderately well drained. These soils have a subsoil of loamy sand to sandy loam or clay loam. They are—

Isabella–Ubly loamy sands, 6 to 12 percent slopes.
Isabella–Ubly sandy loams, 6 to 12 percent slopes.
Nester fine sandy loam, 6 to 12 percent slopes.

These soils are moderately well suited to corn, small grains, field beans, and meadow crops, but they are not suited to sugarbeets. They are fertile and have the capacity to furnish moisture needed for growing crops. Because of the slopes, these soils are highly susceptible to water erosion.

Care is needed in selecting a combination of cropping systems and practices for the control of erosion. If terracing is used, all crop residues are returned to the soil, and tillage is kept to a minimum, a suitable cropping system is 3 years of row crops, 1 year of spring grain, and 1 year of hay. If no supporting practices are used, 1 year of a small grain and 2 years of meadow crops should be used. Waterways must be kept in grass and large amounts of organic material added.

These soils are well suited to pasture crops. Alfalfa, clover, birdsfoot trefoil, smooth bromegrass, timothy, and other common forage crops are well suited. Yields are high if fertilizer and lime are applied. In places grazing must be restricted during wet periods.

Soils in this unit are well suited to trees. Yields are above average. Norway spruce, white spruce, and white pine are suitable for planting except in exposed areas, where Austrian pine is suited. For further information, see the section on woodland.

Soil management unit 1.5aC2 (IIIe)

In this unit are moderately sloping soils that are well drained or moderately well drained. The subsoil of these soils ranges from loamy sand to sandy loam or clay loam. The soils in this unit are—

Isabella–Ubly sandy loams, 6 to 12 percent slopes, moderately eroded.
Nester fine sandy loam, 6 to 12 percent slopes, moderately eroded.

These soils are moderately well suited to corn, small grains, and meadow crops, but they are not suited to sugarbeets and field beans. They are fertile, but their productivity has been reduced through erosion. The content of organic matter is low and it is therefore necessary to add organic material. These soils are highly susceptible to water erosion.

If terracing is used, a suitable cropping system is 3 years of row crops, followed by spring grain and 1 year of hay. All residues must be returned, and minimum tillage used. All waterways should be kept in grass.

These soils are well suited to pasture. Alfalfa, clover, birdsfoot trefoil, smooth bromegrass, timothy, and all other common forage crops are well suited. Yields are high if adequate fertilizer and lime are added. Restricting grazing after prolonged rains or in spring helps to avoid puddling.

Trees are not grown on most areas of these soils. If planting is done, use Austrian pine or redcedar.

Soil management unit 1.5aCD3 (VIe)

In this unit are moderately sloping and strongly sloping, well-drained soils. These soils are—

Nester clay loam, 6 to 12 percent slopes, severely eroded.
Nester clay loam, 12 to 18 percent slopes, severely eroded.

These soils have a low content of organic matter. They are severely eroded, and as a result the subsoil is exposed. Their structure is poor, and they are difficult to till. Runoff is rapid. The moisture-supplying capacity is adequate for most crops. In places the limy underlying material is exposed.

These soils are not suited to a regular cropping system and should be kept in legumes, grasses, or trees. All legumes and grasses commonly grown in the county are well suited. Yields are high if adequate fertilizer and lime are applied.

Areas of this soil generally are open, and trees do not grow on them. If trees are planted, planting must be done with care. Suitable trees for planting are Austrian pine or redcedar.

Soil management unit 1.5aD (IVe)

This unit consists of strongly sloping, well drained or moderately well drained soils. These soils have a subsoil of loamy sand to sandy loam or clay loam. They are—

Isabella–Ubly loamy sands, 12 to 18 percent slopes.
Nester fine sandy loam, 12 to 18 percent slopes.
Nester fine sandy loam, 12 to 18 percent slopes, moderately eroded.

Strong slopes make these soils highly susceptible to erosion, and some areas are moderately eroded. The soils are fertile and productive if well managed. Runoff is rapid.

These soils are not well suited to row crops. A suitable cropping system is 1 year of a small grain and 3 or more years of meadow. The soils are well suited to pasture. Yields of forage are high, and the forage crops also reduce the hazard of erosion. Legumes and grasses commonly grown can be used in the pastures, but long-lived legumes are preferred. They reduce the need for frequent reseeding.

If these soils are well managed, yields of woodland products are high. Norway spruce, white spruce, white pine, and Austrian pine generally are suitable for planting. In open or eroded areas, however, Austrian pine or redcedar is suitable.

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Soil management unit 1.5aE (VIe)

The soils in this unit are hilly and are well drained or moderately well drained. These soils have a subsoil of clay loam. They are—

Nester fine sandy loam, 18 to 25 percent slopes.
Nester fine sandy loam, 18 to 25 percent slopes, moderately eroded.

These soils are fertile and have a high capacity to furnish moisture for crops. They are highly susceptible to erosion if cultivated. Runoff is rapid. The steep slopes make it difficult to use farm equipment on these soils.

A cover of legumes, grasses, or trees should be kept on these soils. The legumes and grasses commonly grown in the county produce good yields if adequate fertilizer and lime are applied. If these soils are well managed, yields of woodland products are high. In protected areas suitable trees to plant are Norway spruce, white spruce, white pine, or Austrian pine. In exposed areas use Austrian pine or redcedar.

Soil management unit 1.5aEF3 (VIIe)

Soils in this unit are hilly to steep and are well drained or moderately well drained. These soils are—

Gullied land.
Nester clay loam, 18 to 25 percent slopes, severely eroded.
Nester clay loam, 25 to 55 percent slopes, severely eroded.

Because these soils are severely eroded or gullied, the subsoil is exposed. The gullies are deep and closely spaced. The steep slopes make it risky to use farm equipment on the areas. In places the limy underlying material is exposed.

A cover of grasses or trees should be kept on these soils and not disturbed. The grasses commonly grown make high yields if fertilizer is applied. Trees generally do not grow on these soils. If planting is done, Austrian pine and redcedar are suitable trees to plant. It is questionable, however, that the plantings will be successful.

Soil management unit 1.5aF (VIIe)

Soils in this unit are steep and are well drained or moderately well drained. The subsoil of these soils is loamy sand to sandy loam or clay loam. These soils are—

Isabella–Ubly loamy sands, 25 to 55 percent slopes.
Nester fine sandy loam, 25 to 55 percent slopes.
Nester fine sandy loam, 25 to 55 percent slopes, moderately eroded.
Nester–Iosco–Rubicon association, steep.

These soils are productive and have the capacity to furnish the moisture needed for growing crops. Slopes are too steep for common farm equipment, and water erosion is a hazard.

These soils should be kept in legumes, grasses, or trees. If trees are planted, use Norway spruce, white spruce, white pine, or Austrian pine in protected areas. In unprotected areas plant Austrian pine or redcedar.

Soil management unit 1.5b (IIw)

This unit consists of nearly level to gently sloping, somewhat poorly drained soils that have a moderately fine textured subsoil. These soils are—

Bowers loam.
Bowers silty clay loam.
Kawkawlin loam, 0 to 2 percent slopes.
Kawkawlin loam, 2 to 6 percent slopes.
Twining loam, 0 to 2 percent slopes.
Twining–Belding loamy sands, 0 to 2 percent slopes.
Twining–Belding loamy sands, 2 to 6 percent slopes.
Twining–Belding sandy loams, 0 to 2 percent slopes.
Twining–Belding sandy loams, 2 to 6 percent slopes.

Soils in this unit have a fluctuating water table and are wet during part of the year unless artificial drainage has been provided. Water moves moderately slowly to slowly through these soils. As a result, the soils warm up slowly in spring. These soils ought not be tilled when wet.

If these soils are adequately drained, they are productive, and most of them are well suited to all crops commonly grown in the county. The Twining-Belding loamy sands, however, are moderately well suited to crops. Drainage is needed if these soils are used for field crops. Row crops can be grown consecutively if all residues are returned, if minimum tillage is used, and if a cover is grown every year or at least in alternate years. Growing legumes and grasses keeps the soils from packing.

These soils are well suited to pasture, and if they are drained, birdsfoot trefoil and grasses grow well. If the areas are not drained, legumes and grasses that tolerate wetness are best to plant. Restricting grazing during wet periods keeps the soils from packing.

Soils in this unit are fairly well suited to trees. The trees now on the areas are of low quality. These soils are seldom planted to trees because the areas are valuable for crops. If planting is done, use Austrian pine or redcedar on the ridges.

Soil management unit 1.5c (IIw)

This unit consists of nearly level, very poorly drained soils that have a moderately fine textured subsoil. The soils are—

Hettinger clay loam.
Hettinger loam.
Hettinger silty clay loam.
Lacota loam.
Lacota sandy clay loam.
Lacota silty clay loam.
Sims clay loam.
Sims loam.
Sims loamy sand.
Sims sandy loam.
Wisner clay loam.
Wisner loam.
Wisner sandy loam.

These soils are very poorly drained, and water moves slowly to moderately slowly through them. Excess water must be removed before the areas can be used for crops. The soils are productive if adequately drained. Lime is seldom required. The surface layer of the Wisner soils is calcareous, and these soils generally are deficient in manganese. All soils in this unit furnish adequate moisture for all crops commonly grown in the county. Yields are good.

Row crops can be grown consecutively if these soils are adequately drained, a cover crop is grown in alternate years, all residues are returned, and minimum tillage is used. Drainage can be provided by use of tile, which in these soils can be installed and maintained easily. Growing legumes and grasses keeps the soils from becoming hard and crusty.

Soils in this unit are well suited to pasture, and if adapted species are grown, yields are high. The kinds of forage that can be grown depend on the degree of artificial drainage. Restricting grazing during wet periods prevents packing of the soils.

These soils are poorly suited to trees. The trees are of low quality and are subject to windthrow. Yields are also low. Trees are seldom planted on these soils, but if planting is done, plant on sites that have been drained. White pine, white spruce, and white-cedar are suitable for drained areas.

Soil management unit 3aA (IIs)

This unit consists chiefly of nearly level, well drained or moderately well drained soils that have a subsoil of medium texture. A small acreage is gently sloping and sloping. The soils are—

Bohemian loamy fine sand, 0 to 2 percent slopes.
Bohemian loamy fine sand, 2 to 6 percent slopes.
Bohemian loamy fine sand, 6 to 12 percent slopes.
Bohemian very fine sandy loam, 0 to 2 percent slopes.
Bohemian very fine sandy loam, 2 to 6 percent slopes.

These soils are moderately well suited to corn, small grain, and hay, but they are poorly suited to field beans and sugarbeets. During dry years these soils lack the moisture needed for growth of crops. Water moves through these soils at a moderate rate. Fertility is moderate. Slopes are more than 3 percent in a small acreage, and here runoff has caused moderate erosion.

Row crops can be grown consecutively on these soils if all residues are returned and minimum tillage is used. In large, exposed areas practices are needed for the control of wind erosion. On slopes of more than 3 percent, terracing and keeping all waterways in grass are ways of controlling erosion.

These soils are well suited to forage crops, but yields are lowered in dry periods. Deep-rooted forage crops that resist drought are best suited to these soils.

The soils in this unit are well suited to trees. Yields are high. Red pine, white pine, and spruce are suitable trees to plant.

Soil management unit 3b (IIw)

This unit consists of nearly level to gently sloping, somewhat poorly drained soils that have a subsoil that is medium textured to moderately coarse textured. These soils are—

Brimley fine sandy loam, 0 to 2 percent slopes.
Brimley fine sandy loam, 2 to 6 percent slopes.
Brimley loam, 0 to 2 percent slopes.
Brimley loam, 2 to 6 percent slopes.
Brimley loamy fine sand, 0 to 2 percent slopes.
Brimley loamy fine sand, 2 to 6 percent slopes.
Richter loam, 0 to 2 percent slopes.
Richter loamy sand, 0 to 2 percent slopes.
Richter sandy loam, 0 to 2 percent slopes.
Richter sandy loam, 2 to 6 percent slopes.
Richter association.

All of the crops common to the county can be grown on these soils if they are drained. Yields are moderate to moderately high. Because of the fluctuating water table, in some periods the water table is at or near the surface unless artificial drainage has been provided. Movement of water through these soils is moderate or is moderately rapid. The content of organic matter is moderately high. These soils are fertile. Their moisture-supplying capacity is moderate.

Row crops can be grown each year on these soils if all crop residues are returned, all other available organic matter is added, minimum tillage is used, and a cover crop is grown in alternate years. Tile can be used to provide drainage. Blinding the tile with topsoil, straw, or similar materials are ways of keeping the tile from filling with soil. Tile can be more satisfactorily installed during dry periods. In some sloping areas the irregularity of the slope makes it difficult to install tile. Fertilizer is needed, but lime generally is not needed.

These soils are well suited to pasture. If adequately drained, all of the common legumes and grasses can be grown on these soils and yields are high. In areas that are not drained, the kinds of plants grown depend on the degree of wetness. Grazing must be restricted during wet periods.

The soils in this unit are poorly suited to trees. The water table is high and favors growth of less desirable trees. Losses from windthrow are high. These soils are seldom planted to trees, but if planting is done, use Norway spruce, white spruce, white pine, or Austrian pine.

Soil management unit 3c (IIw)

This unit consists of nearly level, very poorly drained loamy and sandy soils that have a subsoil of sandy loam. The soils in this unit are—

Bruce fine sandy loam.
Bruce loamy fine sand.
Bruce silt loam.
Tonkey loam.
Tonkey loamy sand.
Tonkey sandy loam.

Soils in this unit have a high water table, and unless they are drained, the water table is at the surface part of the year. Water moves through the soils at a moderate or moderately rapid rate, and the moisture-supplying capacity is high. These soils are high in content of organic matter and are fertile.

If drained, these soils are moderately well suited to the crops commonly grown in the county. Yields are moderately high. Row crops can be grown consecutively if these soils are adequately drained, cover crops are grown in alternate years, all crop residues are returned to the soil, and minimum tillage is used. Fertilizer is needed.

Tile drains are needed for adequate drainage. Because the soils are sandy, tiling should be done during the driest part of the year. Blinding the tile with topsoil, straw, corncobs, or similar material keeps soil from entering the tile.

The soils in this unit are well suited to pasture. If drained, all of the common forage crops can be grown on these soils, and yields are high. In areas that are not drained, the kinds of forage crops grown depend on the degree of wetness. Grazing should be restricted during wet seasons.

Soils in this unit are not suited to trees. The native trees growing on the soils are among the least desirable for woodland. The areas are not well suited to planting. If planting is done, plant on ridges, where the soil is less subject to effects of the high water table, and use Norway spruce, white spruce, white pine, or white-cedar.

Soil management unit 4aA (IIIs)

In this unit are nearly level, well drained or moderately well drained sandy soils that have a moderately coarse textured subsoil. These soils are—

Mancelona loamy sand, 0 to 2 percent slopes.
Rousseau loamy fine sand, 0 to 2 percent slopes.

Soils in this unit are moderately well suited to poorly suited to crops grown in the county and are not suited to sugarbeets. Yields are moderate to low. In most years the supply of moisture for growing crops is not adequate, and in some years yields are lowered even more because moisture is lacking. The content of organic matter is moderate. Water moves freely through these soils.

A suitable cropping system is 2 years of row crops, 1 year of spring grain, and 1 year of meadow. Adding all available organic matter helps to maintain structure. In places wind erosion is a hazard. In large exposed areas practices are needed for the control of wind erosion.

These soils are moderately well suited to forage crops. Yields are greatly reduced in dry periods, and supplemental pasture may be needed. Deep-rooted forage plants that resist drought are suitable plants to grow.

Soils in this unit are well suited to trees. Yields are high to moderately high. In protected areas red pine, jack pine, Scotch pine, or white pine can be planted. In exposed areas plant jack pine, red pine, or Scotch pine.

Soil management unit 4aBC (IIIs)

This unit consists of gently sloping, well drained or moderately well drained sands that have a moderately coarse textured subsoil. These soils are—

Mancelona loamy sand, 2 to 6 percent slopes.
Rousseau loamy fine sand, 2 to 6 percent slopes.

The content of organic matter is moderate in these soils. Water moves freely through these soils, and in most years the soils do not provide adequate moisture for growing plants. Because these soils are sloping, they are subject to water erosion in places.

Most crops commonly grown in the county are moderately well suited to these soils, and yields are moderate to low. Sugarbeets and field beans are poorly suited. A suitable cropping system, if all residues are returned and minimum tillage is used, is 2 years of row crops followed by spring grain and 1 year of meadow. Keep all waterways in grass and add all available organic material.

These soils are moderately well suited to forage crops. Yields are lowered in dry months, and supplemental pasture may be needed. Deep-rooted plants that resist drought are suitable forage plants.

The soils in this unit are well suited to trees. Yields are high to moderately high. Suitable trees to plant in all areas are red pine, jack pine, and Scotch pine, but white pine can also be planted in areas that are not exposed.

Soil management unit 4b (IIIw)

This unit consists of nearly level to gently sloping, somewhat poorly drained soils that have a subsoil of loamy sand. These soils are—

Gladwin loamy sand.
Gladwin–Allendale association, undulating.
Ingalls loamy sand, 0 to 2 percent slopes.
Ingalls loamy sand, 2 to 6 percent slopes.
Wainola loamy fine sand, 0 to 2 percent slopes.
Wainola loamy fine sand, 2 to 6 percent slopes.

These soils are moderately well suited to most crops grown in the county, but they are less well suited to sugarbeets. Yields of most crops are moderate. Moisture sufficient for all crops is available. The soils are moderately high in organic matter. They have a fluctuating water table, and unless they are drained, the water table is likely to be at or near the surface during wet seasons.

A suitable cropping system is 1 year of a row crop, followed by a small grain seeded to a cover crop. Drainage is needed for optimum yields, and tile can be used to provide drainage. The substratum is unstable when wet, however, and the tile must be installed during the driest part of the year. Fertilizer is needed.

Soils in this unit are well suited to pasture. All forage crops grown in the county are well suited if the soils are drained. In areas that are not drained, use plants that tolerate wetness.

These soils are moderately well suited to trees. Trees are seldom planted, but if planting is done, white pine or white spruce is suitable.

Soil management unit 4c (IIIw)

In this unit are nearly level, poorly drained or very poorly drained sandy and loamy soils that have a moderately coarse textured subsoil. These soils are—

Burleigh loamy sand.
Deford loam.
Deford loamy fine sand.
Epoufette sandy loam.
Saganing sandy loam.

Soils in this unit are moderately well suited to all crops grown in the county. Yields are moderately high to moderate if adequate drainage is provided. Moisture needed for all of the crops is available. The content of organic matter is moderately high. The water table is also high, and water is at the surface in places during wet seasons. Water moves freely through these soils.

If these soils are adequately drained and all residues are returned, a suitable cropping system is 1 year of a row crop, followed by a small grain seeded to a cover crop. Tile can be used to provide adequate drainage. The subsoil is unstable, and care is required if tile is laid when the soils are wet. The best time to install tile is in the driest part of the year. Fertilizer is needed, but lime seldom is.

These soils are well suited to pasture, and all forage plants are well suited if the soils have been drained. In some areas that are not drained, use plants that tolerate wetness. Yields of forage are high.

Because of wetness, the soils in this unit are not well suited to trees, and trees are seldom planted. Suitable trees for areas that are drained are white spruce, Norway spruce, or white pine.

Soil management unit 4/1b (IIIw)

Soils in this unit are nearly level to gently sloping and are somewhat poorly drained. These soils are underlain by clay at a depth of 18 to 42 inches. They are:

Allendale loamy sand, 0 to 2 percent slopes.
Allendale loamy sand, 2 to 6 percent slopes.

These soils are moderately well suited to most crops in the county, but they are not suited to sugarbeets. Yields of the crops grown are moderately high if adequate drainage is provided. These soils generally have ample moisture for the crops grown, but in dry years yields are lowered in places. Because of the fluctuating water table, water is at or near the surface in some years. Water moves freely through the upper part of these soils and very slowly through the lower part.

If these soils are adequately drained, and if all residues are returned and minimum tillage is used, a suitable cropping system is 1 year of a row crop, followed by small grain seeded to a cover crop. Adding all other available organic material helps to maintain the soils. Tile can be used for adequate drainage and should be placed above the clay or silty clay substratum. Depth to which the tile should be laid depends on the thickness of the sand. In scattered wet spots it may be necessary to install tile at random to drain the areas. Fertilizer is needed, and tests may show that lime is needed in places.

These soils are well suited to pasture. If the soils have been drained, all of the forage crops grown in the county are well suited. In areas that have not been drained, a seeding mixture that includes some plants that tolerate wetness is needed, because the moisture available varies. Yields of forage are high.

Soils in this unit are poorly suited to trees. Trees are seldom planted, but white pine or white spruce can be planted in areas that have been drained.

Soil management unit 4/1c (IIIw)

Pinconning loamy sand is the only soil in this unit. This soil is nearly level and poorly drained or very poorly drained. It is underlain by clay at a depth of 18 to 42 inches.

This soil is moderately well suited to most crops grown in the county, and yields are moderate. It is poorly suited to sugarbeets. Artificial drainage is needed. The content of organic matter in this soil is high. Moisture needed for growing plants is available. Water moves freely through the sandy upper part of the soil and slowly through the lower part.

Row crops can be grown continuously on this soil if it is adequately drained and a cover crop is grown. Minimum tillage also must be used and all crop residues returned. Tile can be used to provide drainage. If feasible, the tile should be placed on top of the clay layer. Where the clay is at a depth of less than 36 inches, it is necessary to place the tile in the clay. In these places the tile needs to be spaced more closely than when not placed in the clay. Fertilizer is needed, but lime seldom is.

This soil is well suited to pasture, and all forage crops grown in the county are well suited if the soil has been drained. Yields are above average for the county. If this soil has not been drained, grazing must be restricted during wet periods.

Trees are poorly suited to this soil. Yields are low, and the trees are of low value. Trees are seldom planted, but white spruce, Norway spruce, or white pine can be planted in drained areas.

Soil management unit 4/2aA (IIIs)

In this unit are nearly level, well-drained soils underlain by loam to clay loam at a depth of 18 to 42 inches. These soils are—

Manistee loamy sand, 0 to 2 percent slopes.
Menominee loamy sand, 0 to 2 percent slopes.
Menominee sand, 0 to 2 percent slopes.

Soils in this unit are moderately well suited to poorly suited to many cultivated crops but are not suited to sugarbeets and field beans. Yields are less than the average for the county. Moisture for growing crops is lacking during dry periods. The supply of plant nutrients is small, and the soils lack the ability to retain plant nutrients. Water moves freely through the upper part of these soils and moderately slowly or very slowly through the finer textured substratum. These soils are subject to wind erosion.

Adding crop residues frequently helps to maintain these soils. A suitable cropping system is 1 year of a row crop, followed by spring grain seeded to a cover crop. All residues must be returned and minimum tillage used.

These soils are poorly suited to pasture, and yields of forage are less than the average for the county. Suitable plants are deep-rooted legumes and grasses that resist drought. During the dry summer months, supplemental pasture or forage is needed.

Trees are well suited to these soils, and yields of commercially valuable trees are high. Red pine, white pine, jack pine, Austrian pine, and Scotch pine are suitable trees for planting in many areas. In exposed areas plant jack pine, red pine, or Scotch pine.

Soil management unit 4/2aB (IIIs)

This unit consists of gently sloping, well-drained soils underlain by loam to clay loam at a depth of 18 to 42 inches. These soils are—

Manistee loamy sand, 2 to 6 percent slopes.
Menominee loamy sand, 2 to 6 percent slopes.
Menominee sand, 2 to 6 percent slopes.

Soils in this unit are moderately well suited to poorly suited to many cultivated crops but are not suited to sugarbeets and field beans. The yields of the crops grown are less than the average for the county. Moisture is lacking for growing crops during dry periods. The supply of plant nutrients is small, and the soils lack the ability to retain plant nutrients. Water moves freely through the upper part of these soils and moderately slowly or very slowly through the finer textured substratum. These soils are subject to wind and water erosion.

Adding crop residues frequently helps to maintain these soils. A suitable cropping system is 1 year of a row crop, followed by a small grain seeded to a cover crop. Returning all crop residues and using minimum tillage are ways of adding organic matter and controlling erosion.

These soils are poorly suited to pasture, and yields of forage are less than the average for the county. Suitable plants are deep-rooted legumes and grasses that resist drought. During the dry summer months, supplemental pasture or forage is needed.

The soils in this unit are well suited to trees, and yields of commercially valuable trees are high. Red pine, white pine, jack pine, Austrian pine, and Scotch pine are suit-

able trees for planting in many areas. In exposed areas plant jack pine, red pine, or Scotch pine.

Soil management unit 4/2aC (IIIe)

This unit consists of moderately sloping sandy soils that are well drained or moderately well drained. These soils are underlain by loam to clay loam at a depth of 18 to 42 inches. They are—

Menominee loamy sand, 6 to 12 percent slopes.
Menominee sand, 6 to 12 percent slopes.

These soils are moderately well suited to poorly suited to many cultivated crops, but they are not suited to sugarbeets and field beans. Yields are below average. The soils are subject to wind and water erosion and lack sufficient moisture for growing crops during dry periods. Their ability to furnish and hold nutrients is low. Water moves freely through the upper part of the soil profile but moderately slowly through the finer textured substratum.

Frequent additions of crop residues are needed to maintain these soils. A suitable cropping system, if all crop residues are returned to the soils and minimum tillage is used, is 3 years of row crops and 1 year of a small grain. If supporting practices are not used, a suitable cropping system is 1 year of winter grain followed by 2 years of meadow crops. Keeping all waterways in grass helps to control gullies. Areas that have slopes of more than 12 percent are best kept in permanent grass or trees.

These soils are poorly suited to pasture. Yields of forage are lower than the average for the county, and growth of forage decreases in summer. Legumes and grasses that resist drought are therefore needed in the pastures.

Soils in this unit are well suited to trees, and yields of commercially valuable trees are high. Red pine, white pine, jack pine, Austrian pine, and Scotch pine are suitable trees to plant in most places. In exposed areas, however, jack pine, red pine, or Scotch pine are most suitable.

Soil management unit 4/2aD (IVe)

This unit consists chiefly of strongly sloping, well drained or moderately well drained soils underlain by loam to clay loam at a depth of 18 to 42 inches. Because of their small acreage, a few areas are included that are hilly to steep. The soils in this unit are—

Menominee loamy sand, 12 to 18 percent slopes.
Menominee loamy sand, 18 to 25 percent slopes.
Menominee loamy sand, 25 to 45 percent slopes, moderately eroded.

These soils generally are not suited to row crops, but they are moderately well suited to poorly suited to small grains and to hay crops. The hilly and steep areas are not suited to any crops. The hazard of erosion is severe if these soils are cultivated. The moisture-supplying capacity is low, and runoff is rapid. Consequently moisture for plants is lacking in summer. Water moves freely through the upper part of these soils and moderately slowly through the lower part.

These soils are poorly suited to pasture. Because of droughtiness of the soils, deep-rooted legumes and grasses are better suited than shallow-rooted plants. Yields of forage are low in summer.

The soils in this unit are well suited to trees, and yields are high if the woodland is properly managed and fully stocked. Red pine, white pine, jack pine, Austrian pine, or Scotch pine are suitable trees to plant in many areas. In exposed areas plant jack pine, red pine, or Scotch pine.

Soil management unit 4/2b (IIIw)

In this unit are nearly level to gently sloping, somewhat poorly drained soils underlain by loam to clay loam at a depth of 18 to 42 inches. These soils are—

Iosco loamy sand, 0 to 2 percent slopes.
Iosco loamy sand, 2 to 6 percent slopes.
Iosco sand, 0 to 2 percent slopes.
Iosco sand, 2 to 6 percent slopes.
Iosco–Rubicon association, undulating.

The soils in this unit are moderately well suited to most crops grown in the county. They are not well suited to sugarbeets. Yields of the crops grown are moderately high if adequate drainage is provided. Tile can be used to provide adequate drainage. The moisture needed for the crops grown generally is available. In dry seasons, however, yields are lowered by lack of moisture. The soils have a fluctuating water table, and water is at or near the surface in some years. Water moves freely through the upper part of these soils and moderately slowly through the lower part.

If these soils are adequately drained, a suitable cropping system is 1 year of a row crop, followed by a small grain seeded to a cover crop. Minimum tillage must be used, all residues returned, and all other available organic material added.

These soils are well suited to pasture. If they have been drained, all forage crops grown in the county are well suited. In areas that have not been drained, a seeding mixture that includes some plants that tolerate wetness is needed because the supply of moisture is variable. Yields of forage are high.

Trees are poorly suited to these soils. Trees are seldom planted, but white pine or white spruce can be planted in areas that have been drained.

Soil management unit 4/2c (IIIw)

This unit consists of nearly level, poorly drained or very poorly drained soils underlain by loam to clay loam at a depth of 18 to 42 inches. These soils are—

Brevort fine sandy loam.
Brevort loamy sand.
Brevort sand.
Brevort–Kawkawlin association.
Brevort–Roscommon association.
Essexville loamy fine sand.

If these soils are artificially drained, they are moderately well suited to all crops grown in the county. Yields are moderate to moderately high. The moisture needed for growing plants is available. The content of organic matter is high. Water moves freely through the upper part of these soils but moderately slowly through the substratum. The Essexville soil is limy at or near the surface, and in places lacks minor elements for some plants.

If these soils are adequately drained, a suitable cropping system is 1 year of a row crop, followed by a row crop seeded to a cover crop. Minimum tillage must be used, all residues returned, and all other available organic material added. Tile can be used to provide adequate drainage. Fertilizer is needed, but lime is seldom needed.

These soils are well suited to pasture. All forage crops grown in the county are well suited if the soils have been drained, and yields are more than the average for the county. In areas that are not drained, grazing must be restricted during wet periods to avoid trampling.

The soils in this unit are poorly suited to trees. Yields are low, and the trees are of low value. Trees are seldom planted on these soils, but white spruce, Norway spruce, and white pine can be planted in drained areas. It is not practical to plant trees in undrained areas.

Soil management unit 4/RaABC (IVs)

This unit consists of nearly level to moderately sloping, well drained or moderately well drained loamy sands underlain by bedrock at a depth of 18 to 42 inches. These soils are—

Duel loamy sand, 0 to 2 percent slopes.
Duel loamy sand, 2 to 6 percent slopes.
Duel loamy sand, 6 to 12 percent slopes.

These soils are coarse textured, shallow to bedrock, and droughty. They are poorly suited to most crops and are not suited to field beans and sugarbeets. Yields of any crops grown are low. Water moves freely through the upper part of these soils.

Suitability of these soils for pasture is also poor because of droughtiness. If these soils are used for pasture, plant legumes and grasses that resist drought. These soils are moderately well suited to trees. If planting is done, use red pine, jack pine, and Austrian pine.

Soil management unit 5b (IVw)

In this unit are nearly level to gently sloping, somewhat poorly drained soils. These soils are—

Au Gres sand, 0 to 2 percent slopes.
Au Gres sand, 2 to 6 percent slopes.
Au Gres association.
Au Gres–Roscommon association.
Au Gres–Rubicon association.

The soils in this unit have a fluctuating water table, and in undrained areas water is at or near the surface during some seasons. Generally the water table is moderately high and moisture is available for crops unless the soil is overdrained. Fertility is low, and the content of organic matter is moderate. All of the common crops, except sugarbeets and field beans, are suited to these soils. Yields are moderate to low if the soils are properly drained. These soils are subject to wind erosion if they are drained and cultivated.

A suitable cropping system for these soils is 2 years of row crops, 1 year of a small grain, and 1 year of meadow. Minimum tillage must be used and all residues must be returned. Tile can be used to provide drainage, but it must be installed in the driest part of the year. Because these soils are sandy, material is likely to enter the tile and banks of open ditches tend to cave. Fertilizer is needed. Legumes on these soils generally need lime.

These soils are well suited to pasture, and if well managed, yields are moderately high to high. The kinds of legumes and grasses that can be grown depend on the degree of drainage. Grazing must be restricted during wet periods.

The soils in this unit are moderately well suited to trees, but the trees grown are of poor commercial value. Trees are seldom planted on these soils, but if planting is done, use white pine, Norway spruce, or white spruce. White pine is not suitable for planting in extremely wet areas.

Soil management unit 5b-h (VIIw)

In this unit are nearly level, somewhat poorly drained soils that have a hardpan. These soils are—

Saugatuck loamy sand.
Saugatuck sand.

The soils in this unit are wet and acid. The hardpan interferes with the growth of roots. The water table is moderately high, and moisture is therefore available for growing plants. Fertility of these soils is low. Artificial drainage is needed for most cultivated crops.

These soils are not suited to many crops, but they can be used for special crops. They are poorly suited to pasture. Suitable pasture plants are legumes and grasses that tolerate wetness. Restricting grazing during wet seasons helps to prevent damage to plants by trampling.

The soils in this unit are poorly suited to trees. The kinds of trees that can be grown vary, and the rate of growth also varies. The more desirable kinds of trees grow in the higher areas. White pine, Norway spruce, or white spruce are suitable trees for planting if the water table has been lowered.

Soil management unit 5c (IVw)

In this unit are chiefly nearly level, poorly drained or very poorly drained soils that have a coarse-textured subsoil. The Eastport and Rubicon soils are well drained and light colored. The soils in this unit are—

Adrian–Eastport–Rubicon association, undulating.
Maumee mucky loamy sand.
Maumee mucky sandy loam.
Maumee association.
Roscommon loamy sand.
Roscommon sand.
Roscommon association.
Roscommon–Au Gres–Rubicon association, undulating.
Tobico loamy fine sand.
Tobico sandy loam.

The water table is high in these soils, and crops on them are seldom damaged by lack of moisture. Except for the Eastport and Rubicon soils, which have a low content of organic matter, the content of organic matter is high. Fertility is moderate. If the water table has been lowered by artificial drainage, water moves freely through these soils. These soils are subject to wind erosion if drained and cultivated. The Tobico soils are limy at or near the surface and may lack the minor elements needed by growing plants.

These soils are suited to many crops, and yields are moderate. Sugarbeets and field beans are not suited. If these soils are drained, a suitable cropping system is 2 years of row crops and 1 year of a small grain. All crop residues must be returned and minimum tillage used. Because these soils are sandy, it is difficult to install and maintain tile in them. Sand is likely to enter the tile if it is not protected by straw or similar material. Fertilizer is needed. Lime is not needed on the Tobico soils, but tests may show lime is needed on the other soils before legumes can be grown. These soils are moderately well suited to pasture. The kinds of legumes and grasses that can be grown depend on the degree of wetness. If

the soils are drained, use plants that tolerate wetness. Restrict grazing during wet seasons.

The soils in this unit are poorly suited to trees. Yields are low. The trees are of poor quality, and their commercial value is low. Trees are seldom planted on these soils. Planting can be done in drained areas, and white spruce, white pine, and white-cedar are suitable trees to plant.

Soil management unit 5/2aAB (IIIs)

This unit consists of nearly level to gently sloping, well-drained soils underlain by loam to clay at a depth of 42 to 66 inches. These soils are—

Rubicon loamy sand, moderately fine substratum, 0 to 6 percent slopes.
Rubicon sand, moderately fine substratum, 0 to 6 percent slopes.
Rubicon–Iosco association, undulating.

The soils in this unit are poorly suited to most crops commonly grown, and yields are low. Sugarbeets and field beans are not suited. These soils are droughty and lack adequate moisture for growing plants in dry seasons. The crops best suited are those that make most of their growth in spring when moisture is available. Water moves freely through these soils. If these soils are left bare, wind erosion is a hazard in places. The fertility and content of organic matter are low.

A suitable cropping system is 2 years of row crops, 1 year of a small grain, and 1 year of meadow. Minimum tillage must be used, all residues should be returned, and all other available organic matter should be added to the soils.

These soils furnish a fair amount of forage in spring but are poorly suited to summer or fall pasture. Not enough moisture is available in summer for growing plants. Consequently if these soils are used for pasture, deep-rooted legumes and grasses that resist drought are needed.

The soils in this unit are moderately well suited to trees. The fine-textured material underlying these soils helps to hold moisture that can be used by trees. Red pine, jack pine, and Scotch pine are suitable trees to plant.

Soil management unit 5/2aC (IVe)

This unit consists chiefly of moderately sloping, well drained or moderately well drained soils underlain by loam to clay at a depth of 42 to 66 inches. Because of their small acreage two soils are included that are strongly sloping. The soils in this unit are—

Rousseau loamy fine sand, 12 to 18 percent slopes.
Rubicon loamy sand, moderately fine substratum, 6 to 12 percent slopes.
Rubicon sand, moderately fine substratum, 6 to 12 percent slopes.
Rubicon sand, moderately fine substratum, 12 to 18 percent slopes.

These soils are poorly suited to most crops commonly grown, and yields are low to very low. They are not suited to sugarbeets or field beans. These soils are droughty and lack adequate moisture for growing plants in dry seasons. The crops best suited are those that make most of their growth in spring when moisture is available. Wind and water erosion are hazards. The fertility and content of organic matter are low.

If no practices are used for the control of erosion, a suitable cropping system is 1 year each of a row crop and a small grain and 3 years of meadow. If terraces or stripcropping are used, a suitable cropping system is 1 year each of a row crop, a small grain, and meadow. Return all crop residues to the soils and keep tillage to a minimum. Soils that have slopes of more than 12 percent are subject to severe erosion and are not suited to crops. Such soils are best kept in trees or under a cover of permanent grass.

The soils in this unit furnish a fair amount of forage in spring but are poorly suited to summer or fall pasture. Not enough moisture is available in summer for growing plants. Consequently if these soils are used for pasture, deep-rooted legumes and grasses that resist drought are needed.

These soils are moderately well suited to trees. The fine-textured material underlying the soils helps to hold moisture that can be used by trees. Red pine, jack pine, and Scotch pine are suitable trees to plant.

Soil management unit 5/2b (IIIw)

This unit consists of nearly level to gently sloping, somewhat poorly drained soils underlain by loam to clay at a depth of 42 to 66 inches. These soils are—

Au Gres sand, loamy substratum, 0 to 2 percent slopes.
Au Gres sand, loamy substratum, 2 to 6 percent slopes.

Soils in this unit are moderately well suited to some crops commonly grown in the county, and yields are moderate. They are not suited to sugarbeets, and yields of field beans are low. These soils are moderately low in fertility. The water table is fairly near the surface, and crops therefore are seldom affected by lack of moisture. Because of the fluctuating water table, artificial drainage is needed to lower the water table.

If all crop residues are returned and minimum tillage is used, a suitable cropping system is 2 years of row crops and 1 year of a small grain. All available organic material should be returned to the soils. Artificial drainage is needed, and can be supplied by open ditches or tile. The driest part of the year is the best time to install a drainage system. These soils are unstable, and soil material is likely to enter the tile or fill the drainage ditch. Before installing tile, investigation of the site is needed.

The soils in this unit are well suited to pasture, and moisture needed for growing plants is available. The plants selected depend on the degree of drainage. Grazing must be restricted during wet seasons.

These soils are not well suited to trees. Yields are low to very low. Most of the trees are the less desirable kinds, and their quality is moderately low. If trees are planted on these soils, use white pine, Norway spruce, or white spruce.

Soil management unit 5.3aCF (VIIs)

This unit consists chiefly of moderately sloping to steep, well drained or moderately well drained sandy soils. These soils are—

Eastport–Rubicon sands, 0 to 6 percent slopes.
Eastport–Rubicon sands, 6 to 12 percent slopes.
Eastport–Rubicon sands, 6 to 12 percent slopes, moderately eroded.

Eastport–Rubicon sands, 12 to 18 percent slopes.
Eastport–Rubicon sands, 12 to 18 percent slopes, moderately eroded.
Eastport–Rubicon sands, 18 to 25 percent slopes, moderately eroded.
Eastport–Rubicon sands, 25 to 45 percent slopes.
Eastport–Rubicon association, rolling.
Eastport–Rubicon–Roscommon association, undulating.
Rubicon sand, 0 to 6 percent slopes.
Rubicon sand, 6 to 12 percent slopes.
Rubicon sand, 12 to 18 percent slopes.
Rubicon sand, 18 to 25 percent slopes.
Rubicon sand, 25 to 45 percent slopes.
Rubicon association, undulating.
Rubicon association, rolling.

These soils are not suited to crops and are poorly suited to trees. They are droughty, and their fertility and content of organic matter are low. These soils are highly susceptible to wind erosion if left bare or if they are sparsely covered. Because of the steep slopes, these soils are subject to water erosion in places. The steeper slopes hinder use of farm equipment.

If trees are planted on these soils, use red pine, jack pine, or Scotch pine. Areas that have slopes of 25 percent or more generally are too steep to be planted by machine. In areas that are exposed, jack pine is preferred for planting.

Soil management unit 5.7aAC (VIIs)

The land type Grayling association makes up this unit. This land type consists of nearly level to moderately steep, well-drained sandy soils. These soils are droughty, and water moves freely through them. The fertility and content of organic matter are very low.

This land type is not suited to crops or pasture and is very poorly suited to trees. Trees growing on this land type are the less desirable kinds. Yields are very low, and the products are of low quality. If planting is done, use jack pine in exposed areas and jack pine and red pine in other areas.

Soil management unit Lc (Vw)

This unit consists of nearly level, somewhat poorly drained or poorly drained soil material that is coarse textured to fine textured and is along streams. These soils are—

Alluvial land, coarse.
Alluvial land, medium.
Alluvial land, moderately fine.

Soils in this unit are wet and subject to flooding. They therefore are seldom suitable for crops. Drainage and flood prevention measures are needed before the areas can be cropped.

If these soils are adequately drained and protected from flooding, row crops can be grown continuously, and yields are high. Yields of forage on these soils are also high. The legumes and grasses selected for seeding depend on the degree of wetness of the soils. It is necessary to restrict grazing during wet seasons. These soils are poor for trees, and conifers should not be planted.

Soil management unit Mc (IIIw)

This unit consists of nearly level, very poorly drained, deep organic soils. These soils are—

Carbondale muck and peat.
Rifle peat.

The soils in this unit have a high water table. Their capacity to furnish moisture to plants is also high. It is therefore necessary to lower the water table before the soils can be used for crops. These soils have a high content of organic matter but are low in fertility. Consequently fertilizer is needed before crops are grown. The soils are subject to wind erosion and locally to frost.

If these soils are used for crops, all crops except small grains and field beans can be grown, and yields are high. Row crops can be grown continuously. Artificial drainage is needed and can be done by use of open ditches, tile drains, or a combination of the two. A water control system is needed, but the kind of system used depends on the kind of crop to be grown. In areas that have not previously been drained, an open ditch system should be installed prior to placing the tile. In this way, the soil settles and the tile can then be more economically installed. Use of windbreaks, control of runoff, and use of improved tillage methods help to control wind erosion.

Yields of forage crops on soils of this unit are high. The kinds of forage crops grown depend on the degree of wetness of the soils. Also, in wet periods, grazing must be delayed or restricted.

Soils of this unit are poorly suited to trees. Yields are low and the quality of the trees is poor. The soils generally are not suitable for planted trees. Austrian pine, white pine, or Scotch pine, however, are suitable for windbreaks.

Soil management unit Mc-a (VIIIw)

This unit consists of Dawson-Greenwood peats. It is made up of nearly level, very poorly drained, extremely acid, raw, organic material. Because the organic material is raw and extremely acid, it is not suitable for most crops or trees. Some areas are a source of peat.

Soil management unit M/1c (IIIw)

Willette muck is the only soil in this unit. It consists of nearly level, organic material underlain by silty clay or clay at a depth of 12 to 42 inches. The water table is high, and the content of organic matter is also high. Before this soil is used for crops, artificial drainage is needed to lower the water table. Fertility of this soil is low, and the soil is locally subject to frost.

A variety of crops can be grown on this soil, and yields are high. Row crops can be grown continuously if this soil is properly drained. Tile, open ditches, or a combination of the two can be used to provide drainage.

Pastures on this soil are productive, and yields of forage are high. The kinds of forage plants selected for seeding depend on the degree of wetness of the soil. In wet periods grazing must be delayed or restricted.

Suitability of this soil for trees is poor. Yields are low, and the quality of the trees is poor. This soil generally is not suitable for planted trees. Austrian pine, white pine, or Scotch pine, however, are suitable for windbreaks.

Soil management unit M/3c (IIIw)

Linwood peat and muck is the only soil in this unit. It is nearly level and consists of organic material underlain by clay loam at a depth of 12 to 42 inches. The water table is high, and the content of organic matter is

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also high. Before this soil is used for crops, artificial drainage is needed to lower the water table. Fertility of this soil is low, and the soil is locally subject to frost.

A variety of crops can be grown on this soil, and yields are high. Row crops can be grown continuously if this soil is properly drained.

Pastures on this soil are productive, and yields of forage are high. The kinds of forage plants selected for seeding depend on the degree of wetness of the soil. Grazing must be delayed or restricted during wet periods.

Suitability of this soil for trees is poor. Yields are low, and the quality of the trees is poor. Generally trees are not planted on this soil, but Austrian pine, white pine, or Scotch pine can be planted for windbreaks.

Soil management unit M/4c (IVw)

This unit consists of nearly level organic soils that are underlain by sand or loamy sand at a depth of 12 to 42 inches. The soils are—

Adrian muck.
Adrian association.
Markey muck.
Tawas peat, burned.
Tawas peat and muck.
Tawas association.
Tawas–Carbondale association.
Tawas–Roscommon association.

Soils in this unit have a high water table and are able to furnish the moisture needed for growing crops. They are high in organic matter but are shallow over sand. Consequently if the organic layer is destroyed, only sand that is low in fertility is left.

If these soils are used for crops, many kinds of crops can be grown. Drainage is required, and a system to control the water level is needed. Practices that control wind erosion and help to maintain the organic layer are also needed.

These soils are well suited to pasture. Yields of forage are high, but the grasses and legumes that can be grown depend on the degree of wetness of the soils. Grazing must be restricted during wet periods.

Soils in this unit are poorly suited to trees. Yields are low, and the quality of the trees is poor. The soils are generally not planted to trees, but Austrian pine, white pine, or Scotch pine are suitable for planting in windbreaks.

Soil management unit M/mc (IVw)

This unit consists of nearly level organic soils underlain by marl at a depth of less than 42 inches. The soils are—

Edwards muck.
Warners muck and marl.

The water table is high in these soils. Depth to marl ranges from 12 to 42 inches in the Edwards soil, but it is less than 12 inches in the Warners soil. The rate that water moves through the marl varies. Before these soils are used for crops, the water table must be lowered. These soils generally are alkaline. In shallow areas marl is likely to be exposed if plowing is deep or if the organic layer is destroyed.

Soils in this unit are poorly suited to crops. Yields depend on the effectiveness of drainage and the thickness of the organic layer over the marl. The crops used depend on the degree of alkalinity of the soils. Row crops can be grown continuously in areas where depth to marl is more than 20 inches. Practices that help to maintain the organic layer are needed.

These soils are well suited to pasture, and yields of forage are high. The legumes and grasses grown depend on the degree of wetness of the soils. Grazing should be restricted during wet periods. The soils are poorly suited to trees, and trees should not be planted.

Soil management unit RaAB (VIIs)

This unit consists of nearly level to gently sloping, well-drained soils underlain by limestone bedrock at a depth of less than 18 inches. The soils are—

Summerville sandy loam, 0 to 2 percent slopes.
Summerville sandy loam, 2 to 6 percent slopes.

These soils are shallow to bedrock and are droughty. They are not suited to any of the cultivated crops grown in the county and are poorly suited to pasture and trees. Yields of wood products are low.

Soil management unit Sc (VIIIw)

Fresh water marsh, the only soil in this unit, is made up of nearly level, very poorly drained marshland adjacent to lakes. This marsh is not suited to row crops, pasture, or trees. It is wet, and drainage is not feasible. The areas are best suited to wildlife.

Soil management unit Sa (VIIIs)

Lake beach is the only soil in this unit. It consists of well-drained soil material on the coastal beaches of Lake Huron.

This soil is not suited to row crops, pasture, or trees. It is droughty, is low in fertility and in content of organic matter, and is subject to flooding when the level of the lake is high. The value for recreation is high in some areas.

Predicted Yields

The predicted average acre yields of the principal crops grown in Arenac County are given in table 3. The estimates are given for each soil at two levels of management. The data are based on information obtained from farmers, from the members of the staff of the Michigan State Agricultural Experiment Station, from Soil Conservation Service personnel, and from others familiar with the soils and crops of the county.

In columns A are average yields obtained under the management common in the county when the soil survey was made. Lime and fertilizer are applied, but the amount of lime applied is generally small and the fertilizer applied is generally not enough for good yields. Barnyard manure produce on the farms is returned to the soil. In places artificial drainage has been done, but in low areas is still a problem and further drainage is needed. In most places a crop rotation is used that includes some legumes and grasses. On the steep and sandy soils, the rotations include more legumes and grasses than do those on the more nearly level, finer textured soils, where more row crops and small grains are grown.

TABLE 3.—*Predicted average yields per acre of principal crops under two levels of management*

[Yields in columns A are obtained under common management; yields in columns B are obtained under improved management. Dashes indicate the soil is not suited to the crop or that the crop is not generally grown on the soil]

Mapping unit	Corn		Oats		Wheat		Field beans		Sugar-beets		Alfalfa		Mixed hay	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Adrian muck	35	55	----	----	----	----	----	----	10	14	----	----	1.3	2.7
Adrian association	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Adrian-Eastport-Rubicon association, undulating [1]	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Allendale loamy sand, 0 to 2 percent slopes	35	65	37	65	23	38	15	25	7	12	1.5	3.0	1.3	2.7
Allendale loamy sand, 2 to 6 percent slopes	32	60	34	60	21	35	12	20	----	----	1.5	3.0	1.3	2.7
Alluvial land, coarse	30	60	30	60	17	30	13	18	----	----	1.7	3.2	1.2	2.5
Alluvial land, medium	45	85	40	75	27	42	18	27	10	15	1.9	3.6	1.3	2.7
Alluvial land, moderately fine	45	85	40	75	27	42	18	27	10	15	1.9	3.6	1.3	2.7
Arenac (see Au Gres, loamy substratum)	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Au Gres sand, 0 to 2 percent slopes	25	50	30	60	18	30	----	----	----	----	1.6	2.8	1.1	2.3
Au Gres, 2 to 6 percent slopes	15	40	20	50	15	25	----	----	----	----	1.6	2.8	1.1	2.3
Au Gres sand, loamy substratum, 0 to 2 percent slopes	35	60	35	65	22	35	12	20	----	----	1.4	3.0	1.3	2.7
Au Gres sand, loamy substratum, 2 to 6 percent slopes	32	55	30	60	19	31	10	18	----	----	1.4	3.0	1.3	2.7
Au Gres association [2]	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Au Gres-Roscommon association [2]	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Au Gres-Rubicon association [2]	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Bergland mucky loam	50	75	45	70	20	35	21	25	14	18	2.2	3.2	1.8	2.4
Bohemian loamy fine sand, 0 to 2 percent slopes	40	70	35	60	20	35	10	15	5	9	1.5	3.0	1.2	2.5
Bohemian loamy fine sand, 2 to 6 percent slopes	35	65	30	55	20	35	----	----	----	----	1.5	3.0	1.2	2.5
Bohemian loamy fine sand, 6 to 12 percent slopes	30	55	30	45	18	30	----	----	----	----	1.5	3.0	1.2	2.5
Bohemian very fine sandy loam, 0 to 2 percent slopes	50	80	45	75	30	45	21	30	14	18	2.6	3.4	2.0	2.7
Bohemian very fine sandy loam, 2 to 6 percent slopes	45	75	30	70	25	45	12	20	6	10	2.0	3.4	1.4	2.7
Bowers loam	50	85	40	85	28	45	17	28	11	16	2.5	3.7	2.0	2.7
Bowers silty clay loam	40	80	35	75	25	45	14	28	10	15	2.5	3.7	2.0	2.7
Brevort fine sandy loam	30	75	35	70	22	42	15	22	8	13	1.5	3.2	1.3	2.8
Brevort loamy sand	30	70	35	60	18	37	15	20	7	11	1.4	3.0	1.2	2.7
Brevort sand	30	60	30	55	16	30	12	18	----	----	1.4	3.0	1.2	2.7
Brevort-Kawkawlin association	40	80	37	82	25	42	16	25	10	14	2.0	3.6	1.5	2.8
Brevort-Roscommon association	27	60	30	60	18	25	----	----	----	----	1.2	2.8	1.0	2.3
Brimley fine sandy loam, 0 to 2 percent slopes	40	75	40	70	20	40	15	20	8	12	1.9	3.6	1.3	2.7
Brimley fine sandy loam, 2 to 6 percent slopes	40	75	40	70	18	35	12	18	----	----	1.8	3.5	1.2	2.6
Brimley loam, 0 to 2 percent slopes	45	75	45	75	25	35	19	28	13	17	2.2	3.2	1.4	2.4
Brimley loam, 2 to 6 percent slopes	40	75	40	70	20	40	15	20	8	12	1.9	3.6	1.3	2.7
Brimley loamy fine sand, 0 to 2 percent slopes	35	65	35	65	17	35	13	18	----	----	1.7	3.2	1.2	2.5
Brimley loamy fine sand, 2 to 6 percent slopes	30	60	30	60	15	30	12	16	----	----	1.7	3.2	1.2	2.5
Bruce fine sandy loam	45	85	40	75	27	47	18	27	10	15	1.9	3.6	1.3	2.7
Bruce loamy fine sand	35	75	30	60	22	40	15	25	9	12	1.9	3.6	1.3	2.7
Bruce silt loam	45	90	40	75	27	47	18	27	10	15	1.9	3.6	1.3	2.7
Burleigh loamy sand	35	65	35	65	22	40	15	22	8	13	1.5	3.0	1.3	2.7
Carbondale muck and peat	35	60	----	----	----	----	----	----	12	17	----	----	1.3	2.7
Charity silty clay loam	40	85	30	80	20	45	18	30	12	17	1.7	3.5	1.3	2.8
Dawson-Greenwood peats	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Deford loam	35	65	35	65	22	35	15	22	8	13	1.5	3.0	1.3	2.7
Deford loamy fine sand	30	55	30	55	20	32	12	18	7	11	1.4	2.8	1.2	2.6
Duel loamy sand, 0 to 2 percent slopes	25	40	30	50	18	28	----	----	----	----	1.7	2.6	1.1	2.0
Duel loamy sand, 2 to 6 percent slopes	20	35	25	45	16	25	----	----	----	----	1.6	2.3	1.0	1.8
Duel loamy sand, 6 to 12 percent slopes	17	30	25	40	15	22	----	----	----	----	1.5	2.0	.9	1.6
Eastport-Rubicon sands, 0 to 6 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Eastport-Rubicon sands, 6 to 12 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Eastport-Rubicon sands, 6 to 12 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Eastport-Rubicon sands, 12 to 18 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Eastport-Rubicon sands, 12 to 18 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Eastport-Rubicon sands, 18 to 25 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Eastport-Rubicon sands, 25 to 45 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Eastport-Rubicon association, rolling	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Eastport-Rubicon-Roscommon association, undulating	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Edwards muck	35	45	----	----	----	----	----	----	10	15	----	----	1.3	2.7
Epoufette sandy loam	30	60	30	60	21	33	12	18	----	----	1.4	2.8	1.2	2.6
Essexville loamy fine sand	45	65	48	70	23	33	20	29	12	16	1.9	3.0	1.6	2.3
Fresh water marsh	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Gladwin loamy sand	35	65	35	60	22	35	15	22	7	12	1.5	3.0	1.3	2.7
Gladwin-Allendale association, undulating [3]	----	----	----	----	----	----	----	----	----	----	----	----	----	----

See footnotes at end of table.

TABLE 3.—*Predicted average yields per acre of principal crops under two levels of management*—Continued

Mapping unit	Corn		Oats		Wheat		Field beans		Sugar-beets		Alfalfa		Mixed hay	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Gravel and sand pits														
Grayling association														
Gullied land														
Hettinger clay loam	45	85	40	80	20	45	18	30	12	17	2.0	3.8	2.2	3.0
Hettinger loam	50	90	40	85	22	45	20	35	13	18	2.0	3.8	2.2	3.0
Hettinger silty clay loam	45	85	40	80	20	40	18	30	12	17	2.0	3.8	2.2	3.0
Ingalls loamy sand, 0 to 2 percent slopes	30	55	30	50	20	32	11	21	7	11	1.5	3.0	1.3	2.5
Ingalls loamy sand, 2 to 6 percent slopes	30	55	30	50	20	32	11	21			1.5	3.0	1.3	2.5
Iosco loamy sand, 0 to 2 percent slopes	45	65	45	65	22	33	18	26	10	14	2.1	3.1	1.4	2.4
Iosco loamy sand, 2 to 6 percent slopes	25	55	30	60	20	34	10	18			1.5	3.0	1.3	2.5
Iosco sand, 0 to 2 percent slopes	20	50	25	50	20	32					1.3	2.8	1.2	2.3
Iosco sand, 2 to 6 percent slopes	20	45	20	50	20	25					1.3	2.8	1.2	2.3
Iosco-Rubicon association, undulating [4]														
Isabella-Ubly loamy sands, 0 to 2 percent slopes	30	75	30	60	20	35	10	18	6	10	2.0	3.4	1.4	2.7
Isabella-Ubly loamy sands, 2 to 6 percent slopes	30	70	30	60	18	35	10	18	6	10	2.0	3.4	1.4	2.4
Isabella-Ubly loamy sands, 6 to 12 percent slopes	30	55	30	55	16	30	10	15			2.0	3.4	1.3	2.5
Isabella-Ubly loamy sands, 12 to 18 percent slopes			25	50	14	30					1.7	3.3	1.2	2.0
Isabella-Ubly loamy sands, 25 to 55 percent slopes											1.2	3.0	1.0	1.6
Isabella-Ubly sandy loams, 0 to 2 percent slopes	40	80	35	75	35	40	14	25	8	14	2.0	3.7	1.4	2.7
Isabella-Ubly sandy loams, 2 to 6 percent slopes	37	70	35	75	35	40	12	23	7	13	2.0	3.7	1.4	2.7
Isabella-Ubly sandy loams, 2 to 6 percent slopes, moderately eroded	35	60	30	70	28	37					1.9	3.5	1.3	2.6
Isabella-Ubly sandy loams, 6 to 12 percent slopes	35	55	30	65	28	35					2.0	3.7	1.4	2.7
Isabella-Ubly sandy loams, 6 to 12 percent slopes, moderately eroded	30	50	27	60	22	30					1.9	3.5	1.3	2.6
Kawkawlin loam, 0 to 2 percent slopes	50	85	50	85	32	45	25	33	16	18	2.5	4.0	1.7	2.7
Kawkawlin loam, 2 to 6 percent slopes	45	85	35	80	25	45	16	28	10	15	2.5	4.0	2.0	2.7
Kent loam, 0 to 2 percent slopes	40	80	35	75	22	35	12	22	8	14	1.7	3.5	1.3	2.6
Kent loam, 2 to 6 percent slopes	35	75	30	70	20	30	11	20	7	13	1.7	3.5	1.3	2.6
Kent loam, 6 to 12 percent slopes	35	60	30	70	20	28					1.7	3.5	1.3	2.6
Lacota loam	50	90	40	85	22	45	20	30	13	18	2.0	4.0	2.2	3.0
Lacota sandy clay loam	50	90	40	85	22	45	20	30	13	18	2.0	4.0	2.2	3.0
Lacota silty clay loam	40	85	35	80	20	40	18	27	12	16	2.0	4.0	2.2	3.0
Lake beach														
Linwood peat and muck	35	60							12	17			1.3	2.7
Mancelona loamy sand, 0 to 2 percent slopes	25	55	30	55	18	27	9	14	5	9	1.5	2.5	1.1	2.0
Mancelona loamy sand, 2 to 6 percent slopes	25	50	30	55	18	27	9	14	5	9	1.5	2.5	1.1	2.0
Manistee loamy sand, 0 to 2 percent slopes	30	55	35	65	21	32	10	15			1.4	2.8	1.1	2.1
Manistee loamy sand, 2 to 6 percent slopes	25	50	30	60	18	29	9	14			1.4	2.8	1.1	2.1
Markey muck	35	50							10	16			1.3	2.5
Maumee mucky loamy sand	30	45	30	55	18	20			10	15	1.2	2.8	1.0	2.3
Maumee mucky sandy loam	35	50	30	60	20	25			11	16	1.2	2.8	1.0	2.3
Maumee association [5]														
Melita (See Rubicon, moderately fine substratum)														
Menominee loamy sand, 0 to 2 percent slopes	30	55	35	65	21	32	10	15			1.4	2.8	1.1	2.1
Menominee loamy sand, 2 to 6 percent slopes	25	50	30	60	18	29	9	14			1.4	2.8	1.1	2.1
Menominee loamy sand, 6 to 12 percent slopes	20	45	25	55	16	25					1.4	2.8	1.1	2.1
Menominee loamy sand, 12 to 18 percent slopes			20	50	14	22					1.3	2.6	1.0	1.9
Menominee loamy sand, 18 to 25 percent slopes					12	20					1.3	2.6	1.0	1.9
Menominee loamy sand, 25 to 45 percent slopes, moderately eroded											1.2	2.4	.9	1.7
Menominee sand, 0 to 2 percent slopes	25	50	30	55	18	30					1.2	2.4	.9	1.7
Menominee sand, 2 to 6 percent slopes	25	50	30	55	18	30					1.2	2.4	.9	1.7
Menominee sand, 6 to 12 percent slopes	20	45	25	45	15	25					1.2	2.4	.9	1.7
Nester clay loam, 6 to 12 percent slopes, severely eroded											1.7	3.6	1.2	2.5
Nester clay loam, 12 to 18 percent slopes, severely eroded											1.7	3.6	1.2	2.5
Nester clay loam, 18 to 25 percent slopes, severely eroded													1.1	2.3
Nester clay loam, 25 to 55 percent slopes, severely eroded													1.0	2.0
Nester fine sandy loam, 0 to 2 percent slopes	50	75	40	75	28	40	20	25	8	14	2.4	3.5	1.6	2.7
Nester fine sandy loam, 2 to 6 percent slopes	50	70	40	70	27	40	20	25	8	14	2.4	3.5	1.6	2.7
Nester fine sandy loam, 2 to 6 percent slopes, moderately eroded	40	75	30	70	22	35	11	20			1.8	3.4	1.2	2.7
Nester fine sandy loam, 6 to 12 percent slopes	40	70	40	60	27	40	20	25			2.4	3.5	1.6	2.7
Nester fine sandy loam, 6 to 12 percent slopes, moderately eroded	35	65	35	60	24	38					1.8	3.4	1.2	2.7

See footnotes at end of table.

TABLE 3.—*Predicted average yields per acre of principal crops under two levels of management*—Continued

Mapping unit	Corn		Oats		Wheat		Field beans		Sugar-beets		Alfalfa		Mixed hay	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Nester fine sandy loam, 12 to 18 percent slopes			20	55	16	30					2.0	3.7	1.4	2.7
Nester fine sandy loam, 12 to 18 percent slopes, moderately eroded			15	50	14	25					1.8	3.7	1.2	2.7
Nester fine sandy loam, 18 to 25 percent slopes					12	20					2.0	3.7	1.4	2.7
Nester fine sandy loam, 18 to 25 percent slopes, moderately eroded											1.8	3.7	1.2	2.8
Nester fine sandy loam, 25 to 55 percent slopes											1.8	3.5	1.1	2.6
Nester fine sandy loam, 25 to 55 percent slopes, moderately eroded											1.6	3.5	1.0	2.6
Nester loam, 2 to 6 percent slopes	50	80	35	80	25	45	15	28	9	15	2.0	3.8	1.4	2.8
Nester silty clay loam, 2 to 6 percent slopes	50	75	35	75	25	40	14	25	8	14	2.0	3.7	1.4	2.7
Nester-Iosco-Rubicon association, steep														
Pickford fine sandy loam	40	80	30	75	20	32	18	30	12	17	1.7	3.5	1.3	2.6
Pickford loamy sand	35	75	25	65	18	30	16	27	11	16	1.7	3.5	1.3	2.6
Pickford silty clay	40	80	30	75	20	32	18	30	12	17	1.7	3.5	1.3	2.6
Pickford silty clay loam	40	75	30	75	20	32	18	30	12	17	1.7	3.5	1.3	2.6
Pinconning loamy sand	30	70	35	70	22	37	15	22	8	13	1.5	3.2	1.3	2.8
Richter loam, 0 to 2 percent slopes	40	70	40	60	22	35	16	25	9	14	1.9	3.6	1.3	2.7
Richter loamy sand, 0 to 2 percent slopes	35	60	35	60	18	30	15	22	8	10	1.8	3.5	1.2	2.5
Richter sandy loam, 0 to 2 percent slopes	40	70	40	60	22	35	16	25	9	14	1.9	3.6	1.3	2.7
Richter sandy loam, 2 to 6 percent slopes	35	65	35	60	18	30	15	22	8	10	1.8	3.5	1.2	2.5
Richter association	30	55	30	50	18	22	10	18			1.8	3.5	1.2	2.5
Rifle peat	35	45							12	16			1.5	2.7
Roscommon loamy sand	25	55	30	55	15	25					1.2	2.8	1.0	2.3
Roscommon sand	20	50	25	45	10	20					1.0	2.7	.9	2.2
Roscommon association [6]														
Roscommon-Au Gres-Rubicon association, undulating [6]														
Rousseau loamy fine sand, 0 to 2 percent slopes	25	55	30	45	17	24					1.5	3.0	1.2	2.5
Rousseau loamy fine sand, 2 to 6 percent slopes	20	55	25	40	15	22					1.5	3.0	1.2	2.5
Rousseau loamy fine sand, 12 to 18 percent slopes			20	40	12	20					1.5	3.0	1.2	2.5
Rubicon loamy sand, moderately fine substratum, 0 to 6 percent slopes	20	45	20	30	15	25					1.4	2.8	1.0	2.0
Rubicon loamy sand, moderately fine substratum, 6 to 12 percent slopes	20	35	10	25	15	20					1.4	2.8	1.0	2.0
Rubicon sand, 0 to 6 percent slopes														
Rubicon sand, 6 to 12 percent slopes														
Rubicon sand, 12 to 18 percent slopes														
Rubicon sand, 18 to 25 percent slopes														
Rubicon sand, 25 to 45 percent slopes														
Rubicon sand, moderately fine substratum, 0 to 6 percent slopes	15	30	10	25	10	20					1.0	1.5	.7	1.2
Rubicon sand, moderately fine substratum, 6 to 12 percent slopes	10	25	10	20	10	18					1.0	1.5	.7	1.2
Rubicon sand, moderately fine substratum, 12 to 18 percent slopes											1.0	1.5	.7	1.2
Rubicon association, rolling														
Rubicon association, undulating														
Rubicon-Iosco association, undulating [6]														
Rudyard silty clay loam, 0 to 2 percent slopes	45	70	45	70	22	35	20	28	12	15	2.1	3.1	1.7	2.6
Saganing sandy loam	30	65	25	60	18	30	16	25			1.6	3.2	1.2	2.5
Saugatuck loamy sand														
Saugatuck sand														
Selkirk fine sandy loam, 0 to 2 percent slopes	40	70	45	75	20	40	20	28	12	15	2.1	3.1	1.7	2.6
Selkirk loam, 0 to 2 percent slopes	45	75	40	75	22	34	20	23	12	15	2.1	3.2	1.7	2.6
Selkirk loam, 2 to 6 percent slopes	40	70	35	70	18	40	18	26	10	13	2.1	3.1	1.7	2.6
Selkirk loamy sand, 0 to 2 percent slopes	35	75	25	60	18	40	15	27	10	14	1.7	3.5	1.3	2.6
Selkirk silt loam, 0 to 2 percent slopes	40	80	30	65	20	40	16	30	10	15	1.7	3.5	1.3	2.6
Selkirk silty clay loam, 0 to 2 percent slopes	40	80	30	65	20	40	16	30	10	15	1.7	3.5	1.3	2.6
Sims clay loam	50	85	45	70	32	47	25	35	16	21	2.5	3.6	2.0	2.8
Sims loam	55	85	50	75	33	47	25	35	16	21	2.5	3.6	2.0	2.8
Sims loamy sand	45	80	50	65	30	45	20	28	12	16	2.5	3.6	2.0	2.8
Sims sandy loam	50	85	45	70	31	45	22	30	14	18	2.5	3.6	2.0	2.8
Stone quarries														
Summerville sandy loam, 0 to 2 percent slopes														
Summerville sandy loam, 2 to 6 percent slopes														
Tawas peat, burned														
Tawas peat and muck	30	40							9	13			1.7	2.8
Tawas association [6]														

See footnotes at end of table.

TABLE 3.—*Predicted average yields per acre of principal crops under two levels of management*—Continued

Mapping unit	Corn		Oats		Wheat		Field beans		Sugar-beets		Alfalfa		Mixed hay	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Tawas-Carbondale association [6]														
Tawas-Roscommon association [6]														
Tobico loamy fine sand	25	55	30	55	18	32	10	20			1.6	3.0	1.1	2.4
Tobico sandy loam	30	60	35	60	19	32	12	22			1.6	3.0	1.1	2.4
Tonkey loam	45	80	40	75	26	40	18	27	10	15	1.9	3.6	1.3	2.7
Tonkey loamy sand	40	75	35	70	22	36	15	25			1.8	3.5	1.2	2.6
Tonkey sandy loam	45	80	40	75	26	40	18	27	10	15	1.9	3.6	1.3	2.7
Twining loam, 0 to 2 percent slopes	50	85	40	80	28	47	17	28	11	18	2.5	4.0	2.0	2.8
Twining-Belding loamy sands, 0 to 2 percent slopes	40	75	30	60	21	40	12	23	9	14	2.0	3.4	1.8	2.6
Twining-Belding loamy sands, 2 to 6 percent slopes	35	70	25	55	20	37	10	20	8	12	2.0	3.4	1.8	2.6
Twining-Belding sandy loams, 0 to 2 percent slopes	45	80	35	65	26	38	14	24	10	15	2.3	3.7	1.9	2.7
Twining-Belding sandy loams, 2 to 6 percent slopes	40	75	30	60	23	35	12	22	9	13	2.2	3.5	1.9	2.7
Wainola loamy fine sand, 0 to 2 percent slopes	30	65	35	60	22	35	15	24	7	12	1.5	3.0	1.3	2.4
Wainola loamy fine sand, 2 to 6 percent slopes	30	60	35	55	22	32	15	22	7	11	1.5	3.0	1.3	2.4
Warners muck and marl														
Willette muck	40	55							10	16			1.4	2.8
Wisner clay loam	50	85	45	70	32	47	26	35	18	21	2.5	3.6	2.2	2.8
Wisner loam	55	85	45	75	33	47	26	35	18	21	2.5	3.6	2.2	2.8
Wisner sandy loam	50	85	45	70	31	44	22	30	16	19	2.5	3.6	2.2	2.8

[1] Not suitable for crops, except in small local areas.
[2] Consists of a mixture of many soils and generally is not used for crops. See predicted yields of component soils for potential yields.
[3] Yields variable and depend on component soils in the particular area. See predicted yields of component soils for potential yields.
[4] Not used for crops at present. See predicted yields of component soils for potential yields.
[5] Only a small acreage used for crops. See predicted yields of component soils for potential yields.
[6] Seldom used for crops. See predicted yields of component soils.

The yields in columns B are obtained if management is improved. Under improved management the quantity of lime used is determined by soil tests. The amount of commercial fertilizer applied is based on soil tests and the kind of crop to be grown (*5*). Where needed, an adequate system of artificial drainage is installed. Improved varieties of plants and seeds of high quality are planted. Other conservation practices are used, where needed, to control erosion and to conserve moisture. The cropping systems used are adapted to the soils, and seeding, spraying, and cultivating are done at the proper time.

Woodland

Forest originally covered most of Arenac County. Pines and hardwoods grew on the moraines and outwash plains, and white-cedar and other trees that tolerate wetness grew in the swamps. Cutting of the trees began

TABLE 4.—*Woodland suitability groups of soils, their potential productivity, species*

[Dashes indicate trees not suited or data not available. Fresh water marsh, Gravel and sand pits, Lake beach, and

Woodland suitability group and map symbols	Potential productivity ratings of woodland types [1]				Species priority—
	Pine	Spruce-fir	Aspen-white birch	Northern hardwoods	To favor in existing stands
Group A: Deep, well-drained, coarse textured and moderately coarse textured soils underlain by medium-textured to fine-textured material—BbA, BbB, BbC, BcA, BcB, MdA, MdB, MoA, MoB, MoC, MoD, MoE, MoF2, MsA, MsB, MsC.	High	High	Very high	Very high	Sugar maple, basswood, yellow birch.
Group B: Chiefly deep, well drained and moderately well drained soils that have very slow internal drainage—Gu, IuA, IuB, IuC, IuD, IuF, IwA, IwB, IwB2, IwC, IwC2, KnA, KnB, KnC, NcC3, NcD3, NcE3, NcF3, NfA, NfB, NfB2, NfC, NfC2, NfD, NfD2, NfE, NfE2, NfF, NfF2, NmB, NoB, NrE.	Low	Medium to very high.	Very high	Very high	Sugar maple, basswood, yellow birch, white spruce.

See footnote at end of table.

in the 1870's and continued to about 1925. Most of the cutting was done to obtain timber products, but some was done to clear land for farming.

Woodland suitability groupings

The soils of Arenac County have been placed in woodland suitability groups to assist farmers and others in planning use of the soils for woodland. Each group consists of soils that are similar in the management they require and in potential productivity.

Table 4 gives the woodland suitability groups in the county and lists the map symbols for the soils that are in each group. The table also shows, for each suitability group, potential productivity for pine, spruce-fir, aspen-white birch, and northern hardwoods; gives the species priority to favor in existing stands and in planting; and provides ratings for the major limitations and hazards that affect management. The table provides information that landowners can use in appraising the possible economic returns from woodland that can be gained by improved management. The ratings do not take into account use of the soils for growing of Christmas trees or other special woodland crops. Following are explanations of the terms used in table 4.

Potential productivity ratings.—In table 4 potential productivity is indicated by the terms "very high," "high," "medium," "low," and "very low." These terms are translated into board feet and cords per acre in table 5. The ratings are for well-managed, fully stocked stands of trees, and they express approximate annual growth. The ratings cover a range of productivity, and each soil therefore should be considered separately in determining its potential productivity for trees. Detailed descriptions of the soils are given in the section "Descriptions of the Soils."

Species priority.—The two columns under the heading "Species priority" show the kinds of trees to favor in existing stands and those to favor where planting is necessary. In both columns the trees are listed in order of preference, the most desirable first. Priorities are based on the productivity rating of the soils for the species given and the potential commercial value of the trees.

TABLE 5.—*Potential productivity ratings per acre per year for woodland types*

[>=greater than; <=less than]

Rating	Board feet	Cords
Very high	>325	>1. 2
High	275–325	0. 8–1. 2
Medium	200–275	0. 5–0. 8
Low	125–200	0. 2–0. 5
Very low	<125	<0. 2

Seedling mortality.—This term refers to the expected loss of seedlings as influenced by kinds of soil or topographic conditions when plant competition is assumed not to be a limiting factor. Two of the most important factors considered in rating the soils are depth to water table and droughtiness. The ratings are: *Slight*—ordinarily, adequate natural regeneration will take place. The water table is seldom within reach of the main part of roots of seedlings, and the soil is capable of furnishing adequate moisture to seedlings throughout the growing season. A rating of *moderate* indicates that natural regeneration cannot always be relied upon for adequate and immediate restocking. This may be because the water table is at the level of the tree roots during the early part of the growing season. Or it may be that the soil does not furnish sufficient moisture for the seedlings during the driest part of the growing season and that in extremely dry years there will be insufficient moisture during much of the growing season. A rating of *severe* means that much replanting, special seedbed preparation, and superior planting techniques are needed to assure adequate restocking. It can also mean that the water table is at or near

priority, and ratings for major limitations and hazards affecting management

Stone quarries are not placed in a woodland suitability group, because they are not generally suited to trees]

Species priority—Continued	Limitations and hazards affecting management—					
For planting	Seedling mortality	Plant competition	Insect and disease hazards	Equipment limitations	Erosion hazard	Windthrow hazard
White pine, red pine, white spruce.	Slight	Moderate	Slight	Slight	Slight	Slight.
White spruce, Norway spruce, white pine, white-cedar.	Slight	Severe	Slight	Moderate	Slight to moderate.	Moderate.

TABLE 4.—*Woodland suitability groups of soils, their potential productivity, species priority,*

Woodland suitability group and map symbols	Potential productivity ratings of woodland types [1]				Species priority—
	Pine	Spruce-fir	Aspen-white birch	Northern hardwoods	To favor in existing stands
Group C: Chiefly deep, well-drained, coarse-textured soils— MaA, MaB, RoA, RoB, RoD, RpB, RpC, RtB, RtC, RtD, RvB.	High		Medium	Medium	White pine, sugar maple, red pine, basswood.
Group F: Deep, somewhat poorly drained, coarse-textured soils that have rapid to very slow internal drainage— ArA, ArB, AsA, AsB, Au, Aw, Ax, Sb, Sc, WaA, WaB.	Low	Low	Low	Very low	White pine, aspen, white spruce, balsam fir.
Group G: Deep, somewhat poorly drained soils that have medium to slow internal drainage— AmA, AmB, BtA, BtB, BuA BuB, BvA, BvB, Gm, GnB, IgA, IgB, ImA, ImB, IoA, IoB, IrB, RaA, RbA, RcA, RcB, Re.	Very low to low.	Medium	Low to medium.	Low	White ash, white spruce, basswood.
Group H: Deep, well-drained, coarse-textured soils that have rapid internal drainage— ErB, ErC, ErC2, ErD, ErD2, ErE2, ErF, EsC, EtB, RsB, RsC, RsD, RsE, RsF, RuB, RuC.	Medium		Low		Red pine, white pine, aspen.
Group J: Very poorly drained organic soils that have slow internal drainage— Aa, Ad, AeB, Ca, Eu, Lm, Me, Rf, Tb, Ta, Tc, Td, Te, Wk, Wm.					
Group L: Very poorly drained peats that have slow internal drainage— Dg.					
Group N: Deep, well-drained, coarse-textured soils that have rapid internal drainage— Gr.	Very low to low.		Very low	Very low	Jack pine, red pine
Group O: Deep, well-drained to very poorly drained, coarse textured to moderately fine textured soils on flood plains— An, Ao, Ap.	Low	Low	Low	Very low	White spruce, black spruce, balsam fir.
Group P: Deep, very poorly drained soils that have very slow internal drainage— Ba, Ch, Hc, Hg, Hn, Pc, Pd, Pk, Pm, Sm, Sn, Sp, Sr, Wn, Wo, Ws.		Low	Low	Low	Black spruce, white-cedar, balsam fir.
Group Q: Deep, very poorly drained, coarse textured to moderately coarse textured soils that have rapid internal drainage— Mk, Mm, Mn, Rg, Rh, Rk, RmB, Tf, Tg.		Very low	Very low	Very low	Silver maple, white ash, pin oak.
Group T: Shallow and moderately deep, well-drained, coarse textured to moderately coarse textured soils that have rapid internal drainage in the upper part— DuA, DuB, DuC, SvA, SvB.	Medium to low	Low	Medium	Medium	Sugar maple, basswood, white pine.
Group W: Deep, very poorly drained, coarse textured to moderately fine textured soils that have slow to rapid internal drainage— Bf, Bn, Bo, Br, Bs, Bw, Bx, By, Bz, Dm, Dn, Ew, Ex, La, Lb, Lc, Ps, Sa, Th, Tk, Tm.		Low	Medium	Very low	Black spruce, white spruce, balsam fir.
Group Z: Deep, somewhat poorly drained soils that have slow internal drainage— Be, Bd, KaA, KaB, RyA, SdA, SeA, SeB, SfA, SkA, SlA, TnA, TsA, TsB, TwA, TwB.		Medium	Medium	Medium	White ash, basswood, balsam fir, aspen.

[1] For values in board feet and cords see table 5.

and ratings for major limitations and hazards affecting management—Continued

Species priority—Continued	Limitations and hazards affecting management—					
For planting	Seedling mortality	Plant competition	Insect and disease hazards	Equipment limitations	Erosion hazard	Windthrow hazard
White pine, red pine, white spruce.	Moderate; insufficient moisture during part of the growing season.	Slight	Slight	Slight	Slight	Slight.
White pine, white spruce	Slight to moderate because of water table.	Slight to moderate.	Slight to moderate.	Moderate	Slight	Moderate.
White spruce, Norway spruce, white-cedar, white pine, Austrian pine.	Moderate because of water table.	Moderate	Slight	Moderate	Slight	Moderate.
Red pine, white pine, Jack pine.	Severe; soils are droughty	Slight	Slight	Moderate	Moderate	Slight.
Trees difficult to establish	Severe because of water table.	Severe	Slight	Severe	Slight	Severe.
Not capable of supporting trees; raw, acid peat.						
Jack pine, red pine	Severe; soils are droughty	Slight	Slight	Slight	Moderate	Slight.
White spruce, black spruce	Slight to severe because of water table.	Severe	Slight	Slight to severe.	Slight	Slight to severe.
White spruce, Norway spruce, white pine, white-cedar; plant only if drained.	Severe because of water table.	Severe	Slight	Severe	Slight	Severe.
Not normally planted	Severe because of water table.	Moderate	Slight	Severe	Slight	Severe.
Not normally planted	Moderate; insufficient moisture during part of the growing season.	Slight	Slight	Moderate	Slight	Moderate.
Not normally planted	Severe because of water table.	Severe	Slight	Severe	Slight	Severe.
Not normally planted	Moderate because of water table.	Severe	Moderate	Moderate	Slight	Moderate.

the surface throughout the first half of the growing season, or that there is a shortage of water during much of the growing season every year.

Plant competition.—Plant competition refers to the invasion of a site, which has been disturbed by fire, cutting, or other factors, by undesirable species of brush, trees, and other plants. Such plants compete with desirable kinds of trees and hinder their establishment and growth. The expected hazard from competition by other plants is rated in table 4 as slight, moderate, or severe. A rating of *slight* means that competition from other plants is no special problem and a rating of *moderate* means that plant competition develops but generally does not prevent an adequate stand from being established. A rating of *severe* means that plant competition prevents trees from restocking naturally and that if seedlings are planted, proper management is needed for control of competing plants.

Insect and disease hazards.—The hazards of insects and diseases are also rated as slight, moderate, or severe. Little information is available on damage from insects and diseases, and the ratings are therefore based on soils for which some information is available.

Equipment limitations.—The ratings in the column equipment limitations, refer to the soil characteristics and topographic features that restrict or prevent the use of equipment commonly used in tending or harvesting the trees. The ratings are slight, moderate, or severe. By *slight* is meant there is no special problem in use of equipment. A rating of *moderate* means that not all types of equipment can be used and that there is a seasonal restriction of less than 3 months when equipment cannot be used. By *severe* is meant that the type of equipment that can be used without damage to the trees is limited and that there is a seasonal restriction of more than 3 months when equipment cannot be used.

Erosion hazard.—The ratings in this column refer to the potential erosion hazard of a soil. If a soil is under a dense stand of trees, undergrowth, shrubs, and other plants and has a fairly thick cover of litter from decaying leaves, needles, and other plant remains on the surface, it is well protected from erosion. When such cover is removed through fire, harvesting of trees, and poor management, erosion results and the productive capacity of the soil is lowered. Preventing fires, constructing and maintaining roads, skid trails, and loading areas with care, and use of other good management practices help to control erosion.

The ratings in table 4 are based on the increasing risk of erosion. *Slight* means that damage from erosion is not likely under ordinary methods of clear cutting. *Moderate* means that, if clear cutting is done, some protective cover must be maintained and care is needed to prevent skid marks from forming gullies. A rating of *severe* means that gullies form readily and cut rapidly and deeply into the soil material, that wind causes blowouts in areas that are left without a protective cover, and that clear cutting can be done only if the areas have a dense ground cover. Also, roads and trails wash out frequently, unless they are properly laid out and stabilized with compacted soil material or are otherwise maintained.

Windthrow hazard.—The hazard of windthrow is an evaluation of soil characteristics that control the development of tree roots affecting windfirmness. A rating of *slight* means that the trees are well anchored and windthrow is not common. *Moderate* means that the trees remain standing during windstorms of medium intensity, that scattered windthrow can be expected on unprotected sites, and that protective measures must be observed, especially in harvesting and release cutting. The rating *severe* indicates that a high water table or a hardpan or other restrictive layer limits the depth of rooting and does not permit adequate stability.

Engineering Uses of the Soils

This section describes the properties of the soils that are important to engineering. Soil properties are of special interest to engineering because they affect the construction and maintenance of highways, airports, pipelines, building foundations, structures for controlling erosion and facilities for storing water, draining and irrigating soils, and disposing of sewage. The properties most important to the engineer are permeability, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, and soil reaction or pH. Topography and depth to water table, to bedrock, or to sand and gravel are also important.

Some of the properties of soil important to engineering are described in this section. The information can be used by engineers along with other information in the report to—

1. Make soil and land use studies that will aid in selecting and developing sites for industrial, business, residential, and recreational uses.
2. Make estimates of the engineering properties of soils for use in the planning of agricultural drainage systems, waterways, farm ponds, irrigation systems, terraces and diversions, and other structures for conserving soil and water.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, cables, and sewage disposal fields and in planning detailed surveys of the soils at the selected locations.
4. Locate probable sources of sand, gravel, and other material for use in construction.
5. Correlate pavement performance with the soil mapping units and thus develop information that will be useful in designing and maintaining the pavements.
6. Determine the suitability of soils for movement of vehicles and construction equipment.
7. Supplement information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

Used with the soil map to identify the soils, the engineering interpretations in this section can be useful for many purposes. It should be emphasized that the interpretations may not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads or where the excavations are deeper

than the depths of layers here reported. Nevertheless, even in such situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that can be expected.

Some of the terms used by the soil scientists may be unfamiliar to the engineer, and some words, for example, soil, clay, silt, and sand, may have special meanings in soil science. These and other special terms that are used are defined in the Glossary at the back of the report.

Some of the information useful for engineering can be obtained from the soil map. For more information on the soils, however, it is necessary to refer to other parts of the report, particularly to the sections "Descriptions of the Soils" and "Formation, Classification, and Morphology of Soils."

Engineering classification systems

The United States Department of Agriculture system of classifying soil texture is used by agricultural scientists. In this system the textural class of a soil is based on the proportions of sand, silt, and clay in the soil (*6*). In some ways this system of classifying soils is comparable to the systems engineers use in classifying soils.

Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (AASHO) (*1*). In this system soil materials are classified in seven principal groups. The groups range from A–1, consisting of gravelly materials of high bearing capacity, to A–7, consisting of clay soils that have low strength when wet. Within each group the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best material to 20 for the poorest. The group index number is shown in parentheses after the soil group symbol in table 6.

Some engineers prefer to use the Unified soil classification (*7*). In this system soil materials are classified as coarse grained, eight classes; fine grained, six classes; and highly organic material. These classes, designated by pairs of letters, range from GW to Pt. Class GW consists of well-graded gravel or mixture of gravel and sand that contain little or no fines. Class Pt consists of peat and other highly organic soils. Dual classification symbols are provided for soils that have characteristics of two classes. The last column of table 6 gives the classification of the tested soils of Arenac County, according to the Unified System.

Engineering test data

Engineering test data made on some representative soils of the county are given in table 6. The data in this table are the results of tests made in the laboratories of the Bureau of Public Roads. Tests were done in accordance with standard procedures of the American Association of State Highway Officials.

The soil samples represented in table 6 were taken from major horizons of the soils at representative sites. They do not represent the entire range of properties of soils in the county or even of those properties within the five series sampled.

The engineering classifications in table 6 are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods. Percentages of silt and clay determined by the hydrometer method should not be used in naming textural classes for soil classification. The information is useful, however, in determining general engineering properties of the soils.

Some terms used by soil scientists, as terms for soil texture, have different meaning to engineers. For example, clay in present usage in many soil laboratories refers to mineral grains less than 0.002 millimeter in diameter. Engineering tests report as clay, however, mineral grains less than 0.05 millimeter in diameter. These and other terms used by soil scientists are defined in the "Soil Survey Manual" (*6*).

Moisture density, the relation of moisture content and the density to which a soil material can be compacted, is also given in table 6. If soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the optimum moisture content is reached. After that the density decreases with increase in moisture content. The highest dry density obtained in the compaction test is termed maximum dry density. Moisture-density data are important in construction work, for, as a rule, optimum stability is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

The tests to determine liquid limit and plastic limit measure the effect of water on consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The *plastic limit* is the moisture content at which the soil material passes from a semisolid to a plastic state. The *liquid limit* is the moisture content at which the soil material changes from plastic to liquid. The *plasticity index* is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition. A nonplastic soil is a soil that is granular or without cohesion. For such soils the liquid limit or plastic limit cannot be determined.

Engineering descriptions of the soils

In table 7 the soils in the county and the map symbols for each are listed and the estimated physical and chemical properties are given. Information given in the rest of the report and experience with similar soils in this and other counties were used in preparing the data.

In general the information in the table applies to a depth of 5 feet or less. Depth from the surface is normally given only for the major horizons, but other horizons are indicated if they have engineering properties significantly different from adjacent horizons.

TABLE 6.—*Engineering test data for soil samples taken*

[Tests performed by Bureau of Public Roads (BPR) in accordance with standard procedures of State

Soil name and location	Parent material	BPR report No.	Depth	Horizon	Moisture-density		Mechanical analyses [1]		
					Maximum dry density	Optimum moisture	Percentage passing sieve [2]—		
							1-in.	¾-in.	½-in.
			Inches		*Lb. per cu. ft.*	*Percent*			
Au Gres sand (modal profile): NE¼SW¼ sec. 27, T. 20 N., R. 3 E.; 0.7 mile east of gas station.	Acid sand.	92039	0–6	A1 & A2	107	13			
		92040	6–12	B22 & B23	110	13			
		92041	12–31	B3	106	14			
Au Gres sand (intergrading toward Roscommon soils): NE¼NE¼ sec. 27, T. 20 N., R. 3 E.	Acid sand.	92070	1–3	A2g	105	13			
		92071	9–12	B22	109	12			
		92072	12–17	B3g	103	15			
Brimley fine sandy loam (modal profile): NE¼NW¼ sec. 27, T. 20 N., R. 5 E.; 250 feet west and 75 feet south of farmhouse.	Stratified silt and very fine sand.	92042	0–9	A1 & A2	115	13			
		92043	9–20	B	118	13			
		92044	20–48	C	117	11			
Brimley loam	Stratified silt and very fine sand over till.	92045	0–7	A1 & A2	110	14			
		92046	7–21	B1	114	15			
		92047	21–40	C1	112	13			
		92048	40–44	C2	128	10	100	99	
Brimley loamy fine sand (intergrading toward Wainola soils).	Stratified sand, very fine sand, and silt.	92049	0–7	Ap	111	12			
		92050	16–21	B22 & B23	113	12			
		92051	21–48	C	104	16			
Iosco loamy sand (modal profile): SE¼SW¼ sec. 17, T. 18 N., R. 4 E.	Outwash sand over till.	92076	0–6	A1 & A2	108	12			
		92077	6–12	B	112	11		100	
		92078	26–30	C	121	14		100	
Iosco loamy sand (intergrading toward Nester soils): NW¼SW¼ sec. 17, T. 18 N., R. 4 E.	Outwash sand over till.	92052	0–9	Ap	113	12			
		92053	11–17	B22	110	12			
		92054	19–25	C	125	11			
Iosco sand (intergrading toward Au Gres): SE¼NW¼ sec. 24, T. 19 N., R. 3 E.; 300 feet west of Adams Township Hall.	Outwash sand over till.	92073	0–7	Ap	109	13			
		92074	7–15	B21 & B22	108	14			
		92075	41–48	C1, C2	127	10			
Kawkawlin loam (modal profile): SW¼NE¼ sec. 27, T. 19 N., R. 4 E.; 350 feet east of the northwest corner.	Calcareous glacial till.	92061	4–8	A2	120	11			
		92062	10–19	B2	108	17			
		92063	19–30	C1 & C2	117	13			
Kawkawlin loam (intergrading toward Sims soils): SW¼SW¼ sec. 9, T. 18 N., R. 4 E.	Calcareous glacial till.	92055	0–7	Ap	118	13			
		92056	7–16	B	109	17			
		92057	16	C	126	11		100	
Kawkawlin loam (intergrading toward Nester soils): NW¼SE¼ sec. 17, T. 18 N., R. 4 E.	Calcareous glacial till.	92058	0–7	Ap	119	11	100	98	
		92059	10–26	B	115	16			
		92060	29	C	8	15			

See footnotes at end of table.

from 14 soil profiles, Arenac County, Mich.

Highway Officials (AASHO) (*1*). Absence of figures indicates information was not available or was not obtained]

Mechanical analyses [1]—Continued											Liquid limit	Plasticity index	Classification	
Percentage passing sieve [2]—Continued						Percentage smaller than—								
⅜-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 60 (0.25 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.	0.001 mm.			AASHO	Unified [4]
------	------	100	98	38	7	7	7	3	2	2	[3]	[3]	A-3(0)--------	SP-SM.
------	------	100	99	45	15	13	10	7	6	5	[3]	[3]	A-2(4)--------	SM.
------	------	100	98	54	4	4	3	3	2	1	[3]	[3]	A-3(0)--------	SP.
------	------	100	98	66	6	6	5	3	1	1	[3]	[3]	A-3(0)--------	SP-SM.
------	------	100	98	69	9	9	7	5	4	2	[3]	[3]	A-3(0)--------	SP-SM.
------	------	100	99	63	3	3	3	2	1	1	[3]	[3]	A-3(0)--------	SP.
------	100	99	98	91	61	50	35	22	14	11	22	4	A-4(5)--------	CL-ML.
------	------	------	100	99	69	57	39	27	22	19	28	13	A-6(8)--------	CL.
------	------	------	100	99	68	51	26	13	9	7	16	1	A-4(7)--------	CL.
------	------	------	100	98	84	70	45	24	15	12	29	7	A-4(8)--------	CL.
------	------	------	100	98	87	70	49	37	30	27	33	15	A-6(10)-------	CL.
------	------	------	------	100	89	60	25	10	7	5	20	1	A-4(8)--------	CL
98	96	91	89	81	61	56	44	28	22	17	20	8	A-4(5)--------	CL.
------	------	------	100	80	30	26	18	9	7	5	[3]	[3]	A-2-4(0)------	SM.
------	------	------	100	76	16	13	9	8	8	5	[3]	[3]	A-2-4(0)------	SM.
------	------	------	------	100	45	27	10	5	3	3	[3]	[3]	A-4(1)--------	SM.
------	------	100	94	63	5	5	------	5	5	4	[3]	[3]	A-3(0)--------	SP-SM.
99	98	97	89	63	7	7	7	5	3	2	[3]	[3]	A-3(0)--------	SM.
99	99	97	93	83	71	69	61	46	32	24	27	14	A-6(9)--------	CL.
------	100	99	97	60	16	15	12	6	4	4	[3]	[3]	A-2-4(0)------	SM.
------	------	------	100	72	10	9	7	5	3	3	[3]	[3]	A-3(0)--------	SM.
100	99	98	97	83	60	54	42	32	24	20	24	12	A-6(6)--------	CL.
------	------	100	97	70	12	10	7	5	3	3	[3]	[3]	A-2-4(0)------	SP-SM.
------	------	100	98	71	9	7	5	4	3	3	[3]	[3]	A-3(0)--------	SP-SM.
------	------	100	94	80	59	57	47	30	23	19	22	10	A-4(5)--------	CL.
100	99	98	92	77	59	55	43	24	14	10	19	3	A-4(5)--------	CL.
------	------	100	98	93	86	83	73	53	41	37	45	25	A-7-6(15)-----	CL.
------	------	100	96	88	78	76	64	33	24	20	30	14	A-6(10)-------	CL.
------	100	99	98	83	40	37	30	20	16	15	22	4	A-4(1)--------	SM-SC.
------	100	99	99	91	70	68	61	48	39	34	46	28	A-7-6(15)-----	CL.
99	98	96	95	82	64	63	55	36	26	22	27	14	A-6(7)--------	CL.
97	96	95	93	68	33	28	20	11	7	6	[3]	[3]	A-2-4(0)------	SM.
100	99	98	93	79	62	61	55	41	28	23	37	21	A-6(10)-------	CL.
100	99	98	97	86	68	66	57	40	30	26	33	17	A-6(9)--------	CL.

TABLE 6.—*Engineering test data for soil samples taken from*

Soil name and location	Parent material	BPR report No.	Depth	Horizon	Moisture-density		Mechanical analyses [1]		
					Maximum dry density	Optimum moisture	Percentage passing sieve [2]—		
							1-in.	¾-in.	½-in.
			Inches		*Lb. per cu. ft.*	*Percent*			
Wisner clay loam (modal profile): NW¼NW¼ sec. 16, T. 18 N., R. 5 E.; 450 feet west of the northeast corner.	Glacial till	92064	0–8	Ap	103	18			
		92066	8–18	Cg1	106	18			
		92065	18–40	C2	123	12		100	
Wisner clay loam: SE¼NE¼ sec. 17, T. 18 N., R. 5 E.	Glacial till	92067	0–8	Ap	105	18			
		92068	8–24	Cg1, Cg2	113	15	100	98	
		92069	24	C3	128	11		100	
Wisner clay loam (intergrading toward Charity soils): SW¼SW¼ sec. 34, T. 19 N., R. 5 E.	Glacial till	92079	0–8	Ap	104	18			
		92080	8–12	Cg1	116	15		100	
		92081	27–30	Cg3	123	12	100	99	

[1] Mechanical analyses according to the AASHO Designation: T 88–57 (*1*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data

Also given in table 7 are the textural classification of the U.S. Department of Agriculture, estimates of the Unified classification, and estimates of the classification used by the American Association of State Highway Officials. The figures giving the percentages of material passing through sieves No. 10 and No. 200 are rounded off to the nearest 5 percent. The percentage of material passing the No. 200 sieve approximates the combined amount of silt and clay in a soil.

In the column showing permeability, the rate at which water moves downward through undisturbed soil material is estimated. The estimates are based mainly on texture, structure, and consistence of the soils.

Available water capacity, expressed in inches per inch

TABLE 7.—*Estimated properties of the*

[For data on soils in a complex or undifferentiated

Map symbol	Soil name	Depth to water table	Depth from surface	Classification
				USDA texture
		Inches	*Inches*	
Aa	Adrian muck.	From 0 to 10.	0–30	Muck
Ad	Adrian association.		30–42	Sand and loamy sand
AeB	Adrian-Eastport-Rubicon association, undulating.			
AmA	Allendale loamy sand, 0 to 2 percent slopes.	Generally 18 to 36, but seasonally to 10.	0–25	Sand or loamy sand
AmB	Allendale loamy sand, 2 to 6 percent slopes.		25–60	Clay or silty clay
An	Alluvial land, coarse.	About 10.	0–42 (1)	Stratified gravel, sand, loamy sand, and sandy loam.
Ao	Alluvial land, medium.	About 10.	0–42 (1)	Stratified sandy loam, loam, and silt loam.

See footnotes at end of table.

14 soil profiles, Arenac County, Mich.—Continued

Mechanical analyses [1]—Continued											Liquid limit	Plasticity index	Classification	
Percentage passing sieve [2]—Continued						Percentage smaller than—							AASHO	Unified [4]
¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 60 (0.25 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.	0.001 mm.				
------	------	100	96	81	66	65	58	45	34	29	41	18	A–7–6(10)-----	CL.
------	------	100	97	87	76	76	72	57	43	36	46	26	A–7–6(10)-----	CL.
99	98	95	89	79	65	64	57	41	28	22	26	13	A–6(7)--------	CL.
------	------	100	94	78	60	58	51	39	30	25	37	16	A–6(7)--------	CL.
98	98	97	90	74	56	55	50	40	32	26	37	21	A–6(9)--------	CL.
99	97	94	87	75	58	55	47	32	22	19	22	10	A–4(5)--------	CL.
------	------	100	96	87	75	72	62	45	33	25	42	20	A–7–6(12)-----	CL.
99	98	97	94	88	80	78	70	52	40	32	37	21	A–6(12)-------	CL.
99	98	95	90	80	66	64	55	36	26	20	26	13	A–6(7)--------	CL.

used in this table are not suitable for use in naming textural classes for soils.

[2] Based on total material; laboratory test data corrected for amount discarded in field sampling.

[3] Nonplastic.

[4] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points from A-line are to be given a borderline classification. Examples of borderline classifications obtained by this use are CL–ML and SM–SC.

of soil depth, refers to the approximate amount of capillary water in the soil when wet to field capacity. This amount of water will wet air-dry soil to a depth of 1 inch without deeper penetration.

Reaction as shown in the table is the estimated range in pH values for each major horizon of the soils as determined in the field. It indicates the acidity or alkalinity of the soils. A pH of 7, for example, indicates a neutral soil, a lower pH value indicates acidity, and a higher value indicates alkalinity.

The shrink-swell potential refers to the change in volume of the soil that results from a change in moisture content. The estimates in table 7 are based mainly on the amount and kind of clay in a soil

soils of Arenac County, Mich.

unit, refer to soils of the respective series]

Classification—Continued		Percentage passing sieve—		Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
				Inches per hour	*Inches per inch of soil*	*pH*	
Pt----------	----------	----------	----------	5. 0–10. 0	0. 50	5. 6–7. 0	Moderate.
SP or SM----------	A–3 or A–2---------	95–100	0–15	10. 0+	0. 03	5. 6–7. 0	Low.
SP or SM----------	A–3 or A–2---------	95–100	0–25	5. 0–10. 0	0. 05	6. 1–7. 8	Low.
CH----------	A–7----------	95–100	80–95	0. 05–0. 2	0. 17	7. 0–8. 0	High.
SM----------	A–2 or A–4---------	80. 95	10–40	5. 0–10. 0+	0. 10	6. 0–8. 0	Low.
ML or CL----------	A–4 or A–6---------	90–100	50–80	0. 8–5. 0	0. 18	6. 0–8. 0	Moderate.

See footnotes at end of table.

TABLE 7.—*Estimated properties of the*

Map symbol	Soil name	Depth to water table	Depth from surface	Classification
				USDA texture
		Inches	*Inches*	
Ap	Alluvial land, moderately fine.	About 10.	0–42	Stratified silt loam, clay loam, and silty clay loam.
			(1)	
ArA	Au Gres sand, 0 to 2 percent slopes.	Fluctuates from 10 to more than 42 annually.	0 9	Sand
ArB	Au Gres sand, 2 to 6 percent slopes.		9–17	Sand
Au	Au Gres association.		17–36	Sand
Aw	Au Gres-Roscommon association.			
Ax	Au Gres-Rubicon association.			
AsA	Au Gres sand, loamy substratum, 0 to 2 percent slopes.[2]	Generally 18 to 36, but seasonally to 10.	0 27	Sand, fine sand, or loamy sand
AsB	Au Gres sand, loamy substratum, 2 to 6 percent slopes.[2]		27–54	Sand
			54–66	Loam, clay loam, silty clay loam, or clay.
	Belding loamy sand and loam (mapped only in complexes with soils of the Twining series).	From 12 to 18.	0–20	Loamy sand and loam
			20–66	Clay loam or silty clay loam
Ba	Bergland mucky loam.	From 0 to 10.	0–15	Mucky loam
			15–42	Clay or silty clay
BbA	Bohemian loamy fine sand, 0 to 2 percent slopes.	More than 42.	0–12	Loamy fine sand to loamy very fine sand.
BbB	Bohemian loamy fine sand, 2 to 6 percent slopes.			
BbC	Bohemian loamy fine sand, 6 to 12 percent slopes.		12–28	Fine sandy loam to very fine sandy loam.
			28–63	Stratified silt and very fine sand.
BcA	Bohemian very fine sandy loam, 0 to 2 percent slopes.	More than 42.	0–17	Fine sandy loam and very fine sandy loam.
BcB	Bohemian very fine sandy loam, 2 to 6 percent slopes.		17–48	Stratified silt loam and silty clay loam.
			48–66	Stratified silt loam, very fine sandy loam, and very fine sand.
Be	Bowers loam.	About 12.	0–13	Loam or silty clay loam
Bd	Bowers silty clay loam.		13–30	Silty clay loam or clay loam
			30–42	Stratified silty clay loam and clay loam.
Bf	Brevort fine sandy loam.	About 6.	0–10	Fine sandy loam, loamy sand, or sand.
Bn	Brevort loamy sand.			
Bo	Brevort sand.		10–24	Sand
Br	Brevort-Kawkawlin association.		24–42	Loam, clay loam, or silty clay loam.
Bs	Brevort-Roscommon association.			
BtA	Brimley fine sandy loam, 0 to 2 percent slopes.	From 12 to 18.	0–10	Fine sandy loam or loamy fine sand.
BtB	Brimley fine sandy loam, 2 to 6 percent slopes.			
BvA	Brimley loamy fine sand, 0 to 2 percent slopes.		10–25	Fine sandy loam, very fine sandy loam, or silt loam.
BvB	Brimley loamy fine sand, 2 to 6 percent slopes.		25–42	Stratified very fine sand, loamy very fine sand, very fine sandy loam, fine sandy loam, and silt.
BuA	Brimley loam, 0 to 2 percent slopes.	From 12 to 18.	0–10	Loam
BuB	Brimley loam, 2 to 6 percent slopes.		10–25	Loam, silt loam, or silty clay
			25–42	Stratified very fine sand, very fine sandy loam, loamy very fine sand, fine sandy loam, and silt.

See footnotes at end of table.

soils of Arenac County, Mich.—Continued

Classification—Continued		Percentage passing sieve—		Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	*Inches per hour*	*Inches per inch of soil*	*pH*	
CL	A-6	90–100	70–95	0. 05–0. 8	0. 18	6. 0–8. 0	Moderate.
SP–SM	A-3	90–100	5–10	10. 0+	0. 04	4. 5–6. 0	Low.
SP–SM	A-3	90–100	5–10	10. 0+	0. 03	4. 5–6. 0	Low.
SP	A-3	85–100	0–5	10. 0+	0. 03	4. 5–6. 0	Low.
SP or SM	A-2 to A-3	90–100	0–25	10. 0+	0. 07	5. 0–7. 0	Low.
SP or SP–SM	A-3	90–100	0–10	10. 0+	0. 02	5. 5–7. 5	Low.
CL or CH	A-4, A-6 or A-7	90–100	55–85	0. 02–2. 5	0. 17	7. 0–8. 0	Moderate to high.
SM	A-2	85–95	15–25	2. 5–5. 0	0. 08	6. 1–6. 5	Low.
CL	A-6	80–90	70–95	0. 2–0. 8	0. 18	6. 1–8. 0	Low to moderate.
CL	A-6	90–100	80–95	0. 8–2. 5	0. 21	6. 6–7. 3	Moderate.
CH	A-7	90–100	80–95	<0. 05–0. 8	0. 17	7. 2–8. 0	High.
SM	A-2 and A-4	95–100	20–40	2. 5–5. 0	0. 10	6. 1–7. 8	Low.
SM	A-4 and A-2	95–100	30–45	2. 5–5. 0	0. 11	6. 1–7. 8	Low.
ML	A-4	95–100	60–85	0. 8–2. 5	0. 14	7. 0–8. 0	Low to moderate.
SM or ML	A-4	95–100	40–80	0. 8–2. 5	0. 10	6. 1–7. 8	Low.
CL	A-6	95–100	60–90	0. 2–0. 8	0. 15	6. 6–7. 8	Moderate.
ML	A-4	95–100	55–80	0. 2–2. 5	0. 14	7. 4–8. 0	Low.
ML or CL	A-4 or A-6	95–100	70–85	0. 8–2. 5	0. 18	6. 6–7. 3	Moderate.
CL	A-6 or A-7	95–100	60–90	0. 2–0. 8	0. 17	6. 6–7. 3	Moderate to high.
CL	A-6 or A-7	95–100	60–90	0. 2–0. 8	0. 17	7. 4–8. 0	Moderate to high.
SM	A-2	80–95	20–30	5. 0–10. 0	0. 10	6. 6–7. 8	Low.
SP or SM	A-3 or A-2	80–95	0–15	10. 0+	0. 03	6. 6–7. 8	Low.
CL	A-4 or A-6	85–95	60–90	0. 2–2. 5	0. 17	7. 9–8. 0	Moderate.
SM	A-4 or A-2	80–95	25–45	2. 5–5. 0	0. 13	6. 6–7. 4	Low.
ML	A-4	85–100	60–90	0. 8–2. 5	0. 16	7. 4–8. 0	Low.
ML	A-4	85–100	70–90	0. 2–2. 5	0. 14	7. 4–8. 0	Low.
ML–CL	A-4	90–100	70–90	0. 8–2. 5	0. 16	6. 6–7. 4	Low.
CL	A-6	90–100	70–90	0. 2–2. 5	0. 17	7. 4–8. 0	Moderate.
ML	A-4	85–100	70–90	0. 2–2. 5	0. 14	7. 4–8. 0	Low.

TABLE 7.—*Estimated properties of the*

Map symbol	Soil name	Depth to water table	Depth from surface	Classification: USDA texture
		Inches	*Inches*	
Bw	Bruce fine sandy loam.	About 6.	0–11	Fine sandy loam or loamy fine sand.
Bx	Bruce loamy fine sand.		11–22	Very fine sandy loam, loam, or silt loam.
			22–42	Stratified very fine sand, loamy very fine sand, very fine sand, very fine sandy loam, fine sandy loam, and silt.
By	Bruce silt loam.	About 6.	0–11	Silt loam or loamy fine sand
			11–22	Silt loam, clay loam, or silty clay loam.
			22–42	Stratified loamy very fine sand, very fine sand, very fine sandy loam, fine sandy loam, and silt.
Bz	Burleigh loamy sand.	About 6.	0–12	Loamy sand or sand
			12–25	Sand
			25–42	Stratified very fine sand, very fine sandy loam, silt loam, and silt.
Ca	Carbondale muck and peat.	From 0 to 6.	0–42	Muck or peat
Ch	Charity silty clay loam.	About 6.	0–6	Silty clay loam
			6–42	Silty clay or clay
Dg	Dawson-Greenwood peats.	From 0 to 6.	0–30	Peat
			30–42	Sand
Dm	Deford loam.	About 6.	0–5	Loamy fine sand or loam
Dn	Deford loamy fine sand.		5–42	Stratified loamy fine sand, fine sand, and very fine sand.
DuA	Duel loamy sand, 0 to 2 percent slopes.	More than 60.	0–21	Loamy sand or sand
DuB	Duel loamy sand, 2 to 6 percent slopes.		21–36	Limestone
DuC	Duel loamy sand, 6 to 12 percent slopes.			
ErB	Eastport-Rubicon sands, 0 to 6 percent slopes.	More than 42.	0–60	Sand or fine sand
ErC	Eastport-Rubicon sands, 6 to 12 percent slopes.			
ErC2	Eastport-Rubicon sands, 6 to 12 percent slopes, moderately eroded.			
ErD	Eastport-Rubicon sands, 12 to 18 percent slopes.			
ErD2	Eastport-Rubicon sands, 12 to 18 percent slopes, moderately eroded.			
ErE2	Eastport-Rubicon sands, 18 to 25 percent slopes, moderately eroded.			
ErF	Eastport-Rubicon sands, 25 to 45 percent slopes.			
EsC	Eastport-Rubicon association, rolling.			
EtB	Eastport-Rubicon-Roscommon association, undulating.			
Eu	Edwards muck.	From 0 to 12.	0–22	Muck
			22–42	Marl
Ew	Epoufette sandy loam.	About 6.	0–8	Sandy loam
			8–32	Sand or loamy sand
			32–42	Sand and gravel
			(1)	
Ex	Essexville loamy fine sand.	About 6.	0–9	Loamy fine sand
			9–34	Sand
			34–42	Loam, clay loam, or silty clay loam.

See footnotes at end of table.

soils of Arenac County, Mich.—Continued

Classification—Continued		Percentage passing sieve—		Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
				Inches per hour	*Inches per inch of soil*	*pH*	
SM or ML	A-4	80–95	35–60	2. 5–5. 0	0. 17	6. 6–7. 5	Low.
ML	A-4 or A-6	85–100	60–90	0. 8–2. 5	0. 17	6. 6–7. 5	Low.
ML	A-4	85–100	70–90	0. 2–2. 5	0. 14	7. 4–8. 0	Low.
ML or CL	A-4 or A-6	90–100	70–90	0. 8–2. 5	0. 20	6. 6–7. 5	Low.
CL	A-6	90–100	70–90	0. 8–2. 5	0. 17	6. 6–7. 5	Moderate.
ML	A-4	85–100	70–90	0. 2–2. 5	0. 14	7. 4–8. 0	Low.
SP–SM or SM	A-2	85–100	5–20	10. 0+	0. 10	6. 6–7. 5	Low.
SP–SM	A-3 or A-2	85–100	5–10	10. 0+	0. 03	6. 6–7. 5	Low.
ML	A-4	85–100	70–90	0. 8–5. 0	0. 14	7. 4–8. 0	Low.
Pt				5. 0–10. 0	0. 50	5. 6–6. 5	Low.
CL or CH	A-7 or A-6	95–100	80–95	0. 5–0. 8	0. 21	7. 4–8. 0	Moderate.
CH	A-7	95–100	85–100	<0. 2	0. 17	7. 4–8. 0	High.
				5. 0–10. 0	0. 50	4. 0–5. 0	Low.
SP or SM	A-3 or A-2	80–90	0–15	10. 0+	0. 03	4. 0–5. 5	Low.
SM or ML	A-4 or A-2	80–95	30–80	5. 0–10. 0	0. 15	5. 0–7. 5	Low.
SM or ML	A-4 or A-2	80–95	30–60	5. 0–10. 0	0. 05	7. 4–8. 0	Low.
SM	A-2	75–90	15–30	10. 0+	0. 06	5. 6–7. 3	Low.
				0. 05–0. 8		(3)	Low.
SP or SM	A-3 or A-2	60–90	0–15	10. 0+	0. 2	5. 1–6. 5	Low.
Pt				0. 8–2. 5	0. 50	7. 4–8. 0	Low.
				0. 8–2. 5	0. 20	7. 4–8. 0	Low.
SM	A-2	80–95	15–25	5. 0–10. 0	0. 13	6. 6–7. 8	Low.
SP or SM	A-3 or A-2	80–85	0–20	10. 0+	0. 03	6. 6–7. 5	Low.
SP, GP or SM	A-1	10–60	0–15	10. 0+	0. 01	7. 4–8. 0	Low.
SM	A-2	80–95	20–30	5. 0–10. 0	0. 11	7. 8–8. 0	Low.
SP or SP-SM	A-3 or A-2	80–95	5–15	10. 0+	0. 03	7. 8–8. 0	Low.
CL	A-4 to A-6	85–95	60–90	0. 2–2. 5	0. 16	7. 8–8. 0	Moderate.

TABLE 7.—*Estimated properties of the*

Map symbol	Soil name	Depth to water table	Depth from surface	Classification: USDA texture
		Inches	*Inches*	
Fm	Fresh water marsh.	(4).		
Gm	Gladwin loamy sand.	About 18.	0–23	Loamy sand or sand
			23–42	Stratified coarse and very coarse sand and gravel.
GnB	Gladwin-Allendale association, undulating.	10 to more than 42.	0–20	Loamy sand or sand
			20–36	Coarse sand and gravel
			36–42	Clay
Gp	Gravel and sand pits.	(4).		
Gr	Grayling association.	More than 42.	0–60	Sand
	Greenwood (mapped only in complexes with soils of the Dawson series).		0–50	Peat
			50–60	Sand
Gu	Gullied land.	(4).		
Hc	Hettinger clay loam.	About 6.	0–10	Loam to silty clay loam
Hg	Hettinger loam.		10–42	Stratified clay loam and silty clay loam.
Hn	Hettinger silty clay loam.			
IgA	Ingalls loamy sand, 0 to 2 percent slopes.	About 18.	0–10	Loamy sand
IgB	Ingalls loamy sand, 2 to 6 percent slopes.		10–30	Sand
			30–42	Stratified very fine sand, very fine sandy loam, and silt.
ImA	Iosco loamy sand, 0 to 2 percent slopes.	About 18.	0–8	Sand or loamy sand
ImB	Iosco loamy sand, 2 to 6 percent slopes.		8–32	Sand or loamy sand
IoA	Iosco sand, 0 to 2 percent slopes.		32–42	Loam, clay loam, and silty clay loam.
IoB	Iosco sand, 2 to 6 percent slopes.			
IrB	Iosco-Rubicon association, undulating.			
IuA	Isabella-Ubly loamy sands, 0 to 2 percent slopes.	More than 42.	0–12	Loamy sand or sandy loam
IuB	Isabella-Ubly loamy sands, 2 to 6 percent slopes.		12–32	Clay loam
IuC	Isabella-Ubly loamy sands, 6 to 12 percent slopes.		32–42	Clay loam or sandy clay loam
IuD	Isabella-Ubly loamy sands, 12 to 18 percent slopes.			
IuF	Isabella-Ubly loamy sands, 25 to 55 percent slopes.			
IwA	Isabella-Ubly sandy loams, 0 to 2 percent slopes.			
IwB	Isabella-Ubly sandy loams, 2 to 6 percent slopes.			
IwB2	Isabella-Ubly sandy loams, 2 to 6 percent slopes, moderately eroded.			
IwC	Isabella-Ubly sandy loams, 6 to 12 percent slopes.			
IwC2	Isabella-Ubly sandy loams, 6 to 12 percent slopes, moderately eroded.			
KaA	Kawkawlin loam, 0 to 2 percent slopes.	18 on 0 to 2 percent slopes, and 24 on 2 to 6 percent slopes.	0–10	Loam
KaB	Kawkawlin loam, 2 to 6 percent slopes.		10–22	Clay loam and clay
			22–42	Clay loam or silty clay loam
KnA	Kent loam, 0 to 2 percent slopes.	More than 42.	0–8	Loam or sandy loam
KnB	Kent loam, 2 to 6 percent slopes.		8–22	Clay
KnC	Kent loam, 6 to 12 percent slopes.		22–42	Clay
La	Lacota loam.	About 6.	0–8	Loam, sandy clay loam, or silty clay loam.
Lb	Lacota sandy clay loam.			
Lc	Lacota silty clay loam.		8–34	Sandy clay loam or silty clay loam.
			34–42	Sand and gravel
Lk	Lake beach.	From 6 to 12.	0–60	Stratified sand and gravel
Lm	Linwood peat and muck.	At the surface.	0–19	Peat or muck
			19–42	Fine sandy loam, loam, sandy clay loam, clay loam, or silty clay loam.

See footnotes at end of table.

soils of Arenac County., Mich.—Continued

Classification—Continued		Percentage passing sieve—		Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
				Inches per hour	*Inches per inch of soil*	*pH*	
SM or SP–SM	A–2	80–95	5–20	10.0+	0.05	6.6–7.8	Low.
SP, GP	A–1	20–60	0–5	10.0+	0.01	7.9–8.0	Low.
SP or SM	A–2	80–95	5–20	10.0+	0.05	6.6–7.8	Low.
SP, GP or SM	A–3	20–60	0–10	10.0+	0.01	7.9–8.0	Low.
CH	A–7	95–100	80–95	0.05–0.2	0.17	7.0–8.0	High.
SP	A–3	90–100	0–5	10.0+	0.01	5.5–7.3	Low.
Pt				5.0–10.0	0.50	4.0–5.0	Low.
SP or SM	A–3 or A–2	80–90	0–15	10.0+	0.03	4.0–5.5	Low.
CL	A–6 or A–7	90–100	80–100	0.2–0.8	0.21	6.6–7.5	Low to moderate.
CL	A–6 or A–7	90–100	90–100	0.2–0.8	0.17	7.8–8.0	Low to moderate.
SM	A–2	90–100	15–25	10.0+	0.07	5.6–7.3	Low.
SP or SM	A–3 or A–2	90–100	0–25	10.0+	0.03	6.6–7.3	Low.
ML	A–4	95–100	70–90	0.2–2.5	0.14	7.4–8.0	Low.
SM or SP	A–3 or A–2	90–100	0–25	10.0+	0.06	5.1–7.3	Low.
SM or SP	A–3 or A–2	90–100	0–25	10.0+	0.03	5.1–7.3	Low.
CL	A–6 or A–7	90–100	60–90	0.2–0.8	0.17	7.4–8.0	Moderate.
SM	A–2	85–100	15–30	5.0–10.0	0.05	6.1–7.4	Low.
CL	A–6	85–100	60–90	0.2–0.8	0.17	6.6–7.4	Moderate.
CL	A–6	80–95	60–80	0.2–2.5	0.16	7.4–8.0	Moderate.
CL	A–4	90–100	60–80	0.8–2.5	0.18	6.1–7.3	Low.
CL or CH	A–7	90–100	80–95	0.2–0.8	0.17	6.1–7.5	Moderate to high.
CL	A–6 or A–7	90–100	60–85	0.2–0.8	0.17	7.8–8.0	Moderate.
ML, CL or SM	A–4 or A–6	90–100	40–80	0.8–2.5	0.17	6.1–7.3	Low.
CH	A–7	90–100	85–100	0.2–0.8	0.18	6.6–7.8	High.
CH	A–7	90–100	70–90	0.05–0.2	0.18	7.8–8.0	High.
CL	A–6	85–100	60–85	0.8–2.5	0.21	6.1–7.5	Moderate to low.
CL	A–6	85–100	70–85	0.8–2.5	0.18	6.1–7.5	Moderate.
SP or SM	A–2 or A–1	50–70	0–15	10.0+	0.01	7.8–8.0	Low.
SP, GP, GM, or SM	A–1	40–60	5–15	10.0+	0.02	7.0–7.5	Low.
Pt				5.0–10.0	0.50	5.6–7.3	Low.
ML or CL	A–4 to A–6	85–95	55–85	0.2–2.5	[5] 0.10	6.1–7.5	Moderate.

TABLE 7.—*Estimated properties of the*

Map symbol	Soil name	Depth to water table	Depth from surface	Classification
				USDA texture
		Inches	*Inches*	
MaA	Mancelona loamy sand, 0 to 2 percent slopes.	More than 42.	0–25	Loamy sand or sand
MaB	Mancelona loamy sand, 2 to 6 percent slopes.		25–60	Sand, coarse sand, and gravel
MdA	Manistee loamy sand, 0 to 2 percent slopes	More than 42.	0–36	Loamy sand and sand
MdB	Manistee loamy sand, 2 to 6 percent slopes.		36–40	Clay and silty clay
Me	Markey muck.	At the surface.	0–30	Muck or peat
			30–42	Sand or loamy sand
Mk	Maumee mucky loamy sand.	At the surface.	0–18	Mucky loamy sand or mucky sandy loam.
Mm	Maumee mucky sandy loam.			
Mn	Maumee association.		18–42	Sand
MoA	Menominee loamy sand, 0 to 2 percent slopes.	Below 42 on slopes under 6 percent; below 60 on greater slopes.	0–8	Loamy sand or sand
MoB	Menominee loamy sand, 2 to 6 percent slopes.		8–40	Sand
MoC	Menominee loamy sand, 6 to 12 percent slopes.		40–60	Loam, sandy clay loam, clay loam, or silty clay loam.
MoD	Menominee loamy sand, 12 to 18 percent slopes.			
MoE	Menominee loamy sand, 18 to 25 percent slopes.			
MoF2	Menominee loamy sand, 25 to 45 percent slopes, moderately eroded.			
MsA	Menominee sand, 0 to 2 percent slopes.			
MsB	Menominee sand, 2 to 6 percent slopes.			
MsC	Menominee sand, 6 to 12 percent slopes.			
NcC3	Nester clay loam, 6 to 12 percent slopes, severely eroded.	More than 60.	0–18	Clay loam
NcD3	Nester clay loam, 12 to 18 percent slopes, severely eroded.		18–50	Clay loam
NcE3	Nester clay loam, 18 to 25 percent slopes, severely eroded.			
NcF3	Nester clay loam, 25 to 55 percent slopes, severely eroded.			
NfA	Nester fine sandy loam, 0 to 2 percent slopes.	More than 60.	0–8	Fine sandy loam, loam, or silty clay loam.
NfB	Nester fine sandy loam, 2 to 6 percent slopes.			
NfB2	Nester fine sandy loam, 2 to 6 percent slopes, moderately eroded.		8–28	Clay loam or light clay
			28–50	Clay loam
NfC	Nester fine sandy loam, 6 to 12 percent slopes.			
NfC2	Nester fine sandy loam, 6 to 12 percent slopes, moderately eroded.			
NfD	Nester fine sandy loam, 12 to 18 percent slopes.			
NfD2	Nester fine sandy loam, 12 to 18 percent slopes, moderately eroded.			
NfE	Nester fine sandy loam, 18 to 25 percent slopes.			
NfE2	Nester fine sandy loam, 18 to 25 percent slopes, moderately eroded.			
NfF	Nester fine sandy loam, 25 to 55 percent slopes.			
NfF2	Nester fine sandy loam, 25 to 55 percent slopes, moderately eroded.			
NmB	Nester loam, 2 to 6 percent slopes.			
NoB	Nester silty clay loam, 2 to 6 percent slopes.			
NrE	Nester-Iosco-Rubicon association, steep.			
Pc	Pickford fine sandy loam.	About 6.	0–6	Fine sandy loam or loamy sand
Pd	Pickford loamy sand.		6–30	Clay
			30–42	Clay or silty clay
Pk	Pickford silty clay.	About 6.	0–6	Silty clay or silty clay loam
Pm	Pickford silty clay loam.		6–30	Clay
			30–42	Clay or silty clay
Ps	Pinconning loamy sand.	About 6.	0–7	Loamy sand
			7–30	Loamy sand or sand
			30–42	Clay or silty clay
RaA	Richter loam, 0 to 2 percent slopes.	About 18.	0–16	Loamy sand, sandy loam, or loam
RbA	Richter loamy sand, 0 to 2 percent slopes.		16–42	Stratified loamy sand and sandy loam.
RcA	Richter sandy loam, 0 to 2 percent slopes.			
RcB	Richter sandy loam, 2 to 6 percent slopes.			
Re	Richter association.			

See footnotes at end of table.

soils of Arenac County, Mich.—Continued

Classification—Continued		Percentage passing sieve—		Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
				Inches per hour	*Inches per inch of soil*	*pH*	
SP–SM or SM	A–2 or A–1	80–95	5–25	5.0–10.0	0.05	5.6–7.3	Low.
SP or GP	A–1	30–70	0–5	[6] 10.0+	0.01	7.4–8.0	Low.
SP–SM or SM	A–2 or A–3	90–100	5–25	10.0	0.04	5.1–6.5	Low.
CH	A–7	90–100	80–95	<0.2	0.17	7.4–8.0	High.
Pt				5.0–10.0	0.50	7.3–8.0	Low.
SP–SM or SM	A–3 or A–2	95–100	5–25	10.0+	0.03	7.3–8.0	Low.
Pt or SM	A–2	80–95	15–25	5.0–10.0	0.30	6.6–8.0	Low.
SP–SM or SM	A–3 or A–2	80–95	5–15	10.0+	0.03	7.9–8.0	Low.
SM or SP	A–2 or A–3	90–100	0–15	10.0+	0.04	5.1–6.5	Low.
SP or SM	A–2 or A–3	90–100	0–15	10.0+	0.02	5.6–7.3	Low.
CL	A–6 or A–7	90–100	70–90	0.2–0.8	0.17	7.4–8.0	Moderate.
CL	A–6	90–100	80–95	0.2–0.8	0.18	6.1–7.8	Moderate.
CL	A–6 or A–7	90–100	60–85	0.05–0.8	0.17	7.9–8.0	Moderate.
ML	A–4	90–100	60–85	2.5–5.0	0.13	6.1–7.3	Low.
CL to CH	A–6 or A–7	90–100	80–95	0.2–0.8	0.18	6.1–7.3	Moderate.
CL	A–6 or A–7	90–100	60–85	0.2–0.8	0.17	7.9–8.0	Moderate.
SM	A–2	90–100	20–35	5.0–10.0	0.12	5.6–6.5	Low.
CH	A–7	90–100	80–95	<0.05–0.2	0.17	6.6–7.3	High.
CH	A–7	90–100	80–95	<0.05–0.2	0.17	7.9–8.0	High.
CH	A–7	90–100	80–95	0.2–0.8	0.17	6.6–7.3	Moderate.
CH	A–7	90–100	80–95	<0.05–0.2	0.17	6.6–7.8	High.
CH	A–7	90–100	80–95	<0.05–0.2	0.17	7.9–8.0	High.
SM	A–2	80–95	15–25	5.0–10.0	0.10	6.1–7.3	Low.
SP–SM or SM	A–3 or A–2	80–95	5–20	10.0+	0.03	6.6–7.3	Low.
CH	A–7	90–100	80–95	<0.05–0.2	0.17	7.4–8.0	High.
SM or ML	A–2 or A–4	90–100	25–60	5.0–10.0	0.10	6.1–7.8	Low.
SM	A–2	90–100	15–30	5.0–10.0	0.08	7.4–8.0	Low.

TABLE 7.—*Estimated properties of the*

Map symbol	Soil name	Depth to water table	Depth from surface	Classification
				USDA texture
		Inches	*Inches*	
Rf	Rifle peat.	At the surface.	0–42 (1)	Peat or muck
Rg	Roscommon loamy sand.	About 4.	0–4	Loamy sand or sand
Rh	Roscommon sand.		4–60	Sand
Rk	Roscommon association.			
RmB	Roscommon-Au Gres-Rubicon association, undulating.			
RoA	Rousseau loamy fine sand, 0 to 2 percent slopes.	More than 42.	0–60	Stratified loamy fine sand, fine sand, sand, and loamy sand.
RoB	Rousseau loamy fine sand, 2 to 6 percent slopes.			
RoD	Rousseau loamy fine sand, 12 to 18 percent slopes.			
RsB	Rubicon sand, 0 to 6 percent slopes.	More than 42.	0–6	Sand
RsC	Rubicon sand, 6 to 12 percent slopes.		6–22	Sand
RsD	Rubicon sand, 12 to 18 percent slopes.		22–66	Sand
RsE	Rubicon sand, 18 to 25 percent slopes.			
RsF	Rubicon sand, 25 to 45 percent slopes.			
RuB	Rubicon association, undulating.			
RuC	Rubicon association, rolling.			
RpB	Rubicon loamy sand, moderately fine substratum, 0 to 6 percent slopes.[7]	More than 42.	0–18	Sand or loamy sand
RpC	Rubicon loamy sand, moderately fine substratum, 6 to 12 percent slopes.[7]		18–48	Sand
RtB	Rubicon sand, moderately fine substratum, 0 to 6 percent slopes.[7]		48–66	Loam, clay loam, sandy clay loam, silty clay loam, silty clay, or clay.
RtC	Rubicon sand, moderately fine substratum, 6 to 12 percent slopes.[7]			
RtD	Rubicon sand, moderately fine substratum, 12 to 18 percent slopes.[7]			
RvB	Rubicon-Iosco association, undulating.			
RyA	Rudyard silty clay loam, 0 to 2 percent slopes.	About 15.	0–7	Silty clay loam
			7–18	Clay
			18–42	Clay or silty clay
Sa	Saganing sandy loam.	About 6.	0–15	Sandy loam
			15–24	Sandy clay loam
			24–42	Stratified sand and gravel
Sb	Saugatuck loamy sand.	About 6.	0–8	Sand or loamy sand
Sc	Saugatuck sand.		8–14	Sand
			14–22	Sand or loamy sand
			22–42	Sand
SdA	Selkirk fine sandy loam, 0 to 2 percent slopes.	About 18.	0–12	Loamy sand
SeA	Selkirk loam, 0 to 2 percent slopes.			Silty clay loam
SeB	Selkirk loam, 2 to 6 percent slopes.			Fine sandy loam or silt loam
SfA	Selkirk loamy sand, 0 to 2 percent slopes.		12–21	Clay
SkA	Selkirk silt loam, 0 to 2 percent slopes.		21–42	Clay or silty clay
SlA	Selkirk silty clay loam, 0 to 2 percent slopes.			
Sm	Sims clay loam.		0–7	Loam and clay loam
Sn	Sims loam.			Loamy sand and sandy loam
Sp	Sims loamy sand.		7–32	Clay loam or silty clay loam
Sr	Sims sandy loam.		32–42	Clay loam or silty clay loam

See footnotes at end of table.

soils of Arenac County, Mich.—Continued

Classification—Continued		Percentage passing sieve—		Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
				Inches per hour	*Inches per inch of soil*	*pH*	
Pt				5.0–10.0	0.50	4.5–6.5	Low.
SP–SM or SM	A–3 or A–2	85–100	5–15	10.0+	0.08	5.6–7.3	Low.
SP–SM	A–3	85–100	5–10	10.0+	0.03	5.6–7.3	Low.
SM	A–2	85–100	20–35	5.0–10.0	0.05	5.6–7.3	Low.
SP–SM or SP	A–3	85–100	0–10	10.0+	0.02	4.5–6.5	Low.
SP–SM or SP	A–3	85–100	0–10	10.0+	0.02	5.6–6.5	Low.
SP	A–3	85–100	0–5	10.0+	0.01	6.1–7.3	Low.
SP–SM or SM	A–2 or A–3	90–100	5–15	5.0–10.0	0.04	5.1–6.5	Low.
SP or SM	A–3 or A–2	90–100	0–15	10.0+	0.02	5.1–6.5	Low.
CL or CH	A–6 or A–7	90–100	70–95	0.8	0.17	7.4–8.0	Moderate to high.
CL	A–6	95–100	80–95	0.05–0.2	0.18	6.1–7.3	Moderate.
CH	A–7	95–100	85–100	<0.05–0.2	0.17	6.6–7.8	High.
CH	A–7	95–100	80–95	<0.05–0.2	0.17	7.8–8.4	High.
SM	A–2	80–95	20–35	2.5–5.0	0.15	6.6–7.8	Low.
SC	A–2 or A–4	80–95	30–40	0.8–2.5	0.16	7.4–8.4	Moderate.
SP or GP	A 1	60–80	0–5	10.0	0.01	7.4–8.4	Low.
SP–SM or SM	A–2 or A–3	85–95	5–15	10.0	0.04	5.1–6.5	Low.
SP–SM	A 3	85–95	5–10	10.0	0.02	5.1–6.5	Low.
SP–SM or SM	A–2 or A–3	85–95	5–15	0.2–0.8	0.04	5.1–6.5	Low.
SP	A–3	85–95	0–5	10.0+	0.01	5.1–7.3	Low.
SM	A–2 or A–3	90–100	5–15	5.0–10.0	0.07	6.1–7.3	Low.
CL or CH	A–6 or A–7	90–100	75–90	0.2–0.8	0.18	6.1–7.3	Moderate.
SM or CL	A–4	90–100	40–75	0.8–2.5	0.18	6.1–7.3	Low.
CH	A–7	90–100	85–100	0.05–0.20	0.18	6.6–7.5	High.
CH	A–7	85–100	75–90	0.05–0.20	0.18	7.8–8.0	High.
CL	A–6	85–100	60–80	0.2–0.8	0.21	6.6–7.3	Low.
SM	A–2	85–100	20–35	0.8–2.5	0.18	6.6–7.3	Low.
CL	A–7	90–100	60–85	0.2–0.8	0.18	7.4–8.0	Moderate.
CL	A–6 or A–7	85–100	60–85	0.2–0.8	0.17	7.9–8.0	Moderate.

TABLE 7.—*Estimated properties of the soils*

Map symbol	Soil name	Depth to water table	Depth from surface	Classification
				USDA texture
		Inches	*Inches*	
Su	Stone quarries.[2]			
SvA	Summerville sandy loam, 0 to 2 percent slopes.	More than 60.	0–10	Sandy loam
SvB	Summerville sandy loam, 2 to 6 percent slopes.		10–24	Limestone bedrock
Ta	Tawas peat and muck.	At the surface.	0–30	Peat or muck
Tb	Tawas peat, burned.		30–42	Sand
Tc	Tawas association.			
Td	Tawas-Carbondale association.			
Te	Tawas-Roscommon association.			
Tf	Tobico loamy fine sand.	About 6.	0–3	Loamy fine sand or sandy loam
Tg	Tobico sandy loam.		3–42	Sand
Th	Tonkey loam.	About 6.	0–8	Loamy sand or sandy loam
Tk	Tonkey loamy sand.			Loam
Tm	Tonkey sandy loam.		8–42	Stratified sandy loam and loamy sand.
TnA	Twining loam, 0 to 2 percent slopes.	About 18.	0–18	Loam
TsA	Twining-Belding loamy sands, 0 to 2 percent slopes.		18–30	Clay loam
TsB	Twining-Belding loamy sands, 2 to 6 percent slopes.		30–42	Loam, sandy clay loam, or light clay loam.
TwA	Twining-Belding sandy loams, 0 to 2 percent slopes.			
TwB	Twining-Belding sandy loams, 2 to 6 percent slopes.			
	Ubly (mapped only in complexes with soils of the Isabella series).	12 to 18.	0–20	Sandy loam or loamy fine sand
			20–42	Clay loam
WaA	Wainola loamy fine sand, 0 to 2 percent slopes.	About 14.	0–60	Stratified loamy fine sand, sand, and fine sand.
WaB	Wainola loamy fine sand, 2 to 6 percent slopes.			
Wk	Warners muck and marl.	At the surface.	0–8	Muck
			8–42	Marl
			42–48	(4).
Wm	Willette muck.	At the surface.	0–30	Muck
			30–42	Clay, silty clay, or clay loam
Wn	Wisner clay loam.	About 6.	0–8	Sandy loam or clay loam
Wo	Wisner loam.			Loam
Ws	Wisner sandy loam.		8–18	Clay loam
			18–42	Clay loam

[1] Below a depth of 42 inches material is variable.
[2] Shown as Arenac in material published by the Michigan Experimental Station.
[3] Calcareous.
[4] Variable in all characteristics.
[5] Ranges to 0.18.

Engineering interpretations

Table 8 lists suitability ratings for the soils of the county for specific uses in engineering, including use for highways and for conservation engineering. The data in the table apply to the representative profile of the soil series, which is described in the sections, "Descriptions of the Soils," and "Detailed Descriptions of Soil Series."

The suitability of the soils as a source of topsoil refers specifically to the use of material, preferably rich in organic matter, as a topdressing for back slopes, embankments, lawns, gardens, and so on. The ratings are based mainly on the texture of the soil and its content of organic matter. Unless otherwise indicated, only the surface of the mineral soils is considered suitable as a source of topsoil.

The suitability of the soils as a source of sand and gravel refers to sources of such material that is within a depth of 5 feet from the surface. In some of the soils, depth to sand and gravel is less than 5 feet or is greater than 5 feet. In adjacent areas of the same soil, unsuitable material is just below 5 feet. Also some soils are rated as unsuitable for sand and gravel, but in places such material is at a depth of more than 5 feet. Individual test pits will be needed in such areas to determine the availability of sand and gravel.

Ratings of the suitability of the soils as a source of subgrade material for pavements depend partly on the

of Arenac County, Mich.—Continued

Classification—Continued		Percentage passing sieve—		Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
				Inches per hour	*Inches per inch of soil*	*pH*	
SM	A-2 or A-4	90–100	25–40	2.5–5.0	0.10	6.6–7.5	Low.
				0.5–0.20	0.0	8.0	Low.
Pt				5.0–10.0	0.50	5.6–7.3	Low.
SP–SM or SM	A-3 or A-2	90–100	5–15	10.0+	0.03	7.3–8.0	Low.
SM	A-2	90–100	20–35	5.0–10.0	0.16	6.6–8.0	Low.
SP or SM	A-3 or A-2	75–95	0–15	10.0+	0.01	7.4–8.0	Low.
SM	A-2	90–100	20–35	2.5–5.0	0.12	6.6–8.0	Low.
ML–SM or SM	A-4—A-6	90–100	30–55	2.5–5.0	0.21	6.6–8.0	Low.
SM	A-2	90–100	20–35	5.0–10.0	0.08	7.9–8.0	Low.
ML–CL	A-4—A-6	90–100	55–75	0.8–2.5	0.18	6.1–6.5	Low.
CL	A-6—A-7	90–100	70–85	0.8–2.5	0.17	6.6–7.5	Moderate.
SC or CL	A-6	85–100	40–75	0.8–2.5	0.16	7.4–8.0	Moderate.
SM	A-2	85–95	15–25	2.5–5.0	0.08	6.1–6.5	Low.
CL	A-6	80–90	70–95	0.2–0.8	0.18	6.1–8.0	Low to moderate.
SM	A-2	85–100	15–30	5.0–10.0	0.05	5.6–7.3	Low.
Pt				5.0–10.0	0.50	7.9–8.0	Low.
				2.5–5.0	0.20	7.9–8.0	Low.
Pt				5.0–10.0	0.50	5.6–7.3	Low.
CH	A-7	95–100	90–100	<0.05–0.2	0.17	7.4–8.0	High.
SM or CL	A-4	90–100	40–65	2.5–5.0	0.18	7.9–8.0	Low.
CL	A-6	90–100	50–70	0.8–2.5	0.21	7.9–8.0	Moderate.
CL	A-6 to A-7	90–100	50–80	0.2–0.8	0.18	7.9–8.0	Moderate.
CL	A-6 to A-7	90–100	55–85	0.2–0.8	0.18	7.9–8.0	Moderate.

[6] Less in sticky layers.

[7] Shown as Melita in material published by the Michigan Experimental Station.

[8] Not suited; small areas from which bedrock has been removed

texture of the soil material. If the subsoil and substratum have contrasting characteristics, both are rated. In general sand is the most desirable material for subgrade and clay is the least desirable.

The entire soil profile was rated to determine the suitability of the soils as locations for highways. The ratings were based on undisturbed soils without artificial drainage. Additional information can be obtained from data compiled by the State Highway Department of Michigan, which has rated the major soil series in the State as to their suitability for highway construction. This information is contained in the Field Manual of Soil Engineering (*4*).

The soils are also rated in table 8 as to their suitability for foundations for buildings that are no more than 3 stories high. The suitability of undisturbed soils as a base for low buildings depends mainly on characteristics of the substratum, which generally provides the base for foundations. Ratings are therefore for the substratum. Among the main factors considered in determining the suitability of the soils as foundations for low buildings is the shrink-swell potential. It can be determined for a specific horizon by referring to the column "Shrink-swell potential" in table 7.

Suitability ratings of the soils for domestic sewage disposal systems were based on depth to water table or bedrock, the permeability or percolation rate, the hazard of flooding, and the relief of the soils.

TABLE 8.—*Engineering properties of*

Soil series and map symbols	Suitability as source of—				Soil features affecting suitability for—	
	Topsoil [1]	Sand [1]	Gravel [1]	Road fill	Highway location	Foundations for low buildings
Adrian (Aa, Ad, AeB)	Fair to poor because of acidity.	Good below the organic layers which are 18 to 42 inches thick.[4]	Not suitable	Organic layers are not suitable; underlying sand is good.	High water table; organic layers must be removed.	Moderate frost susceptibility.
Allendale (AmA, AmB, GnB).	Poor	Good in upper 18 to 42 inches.	Not suitable	Sandy layers are good; underlying clay is fair to poor.	Moderately high water table; plastic substratum.	Low bearing strength; high risk of frost heaving; high shrink-swell potential in the substratum.
Alluvial land (An, Ao, Ap).	Fair	Not suitable	Not suitable	Poor; high in organic matter and variable.	Flooding; high water table.	Variable
Au Gres (ArA, ArB, Au, Ax, Aw, RmB).	Poor because of acidity.	Good	Not suitable	Good	High water table	High bearing strength; piping in places; low shrink-swell potential; medium risk of frost heaving.
Au Gres, loamy substratum (AsA, AsB).[5]	Poor	Good to a depth of 42 to 66 inches.	Not suitable	Sandy layers are good; underlying material is variable.	Occasional high water table.	High bearing strength; piping in places; very low shrink-swell potential in upper 42 to 66 inches but high below; medium risk of frost heaving.
Belding (TsA, TsB, TwA, TwB; mapped only with Twining soils).	Fair	Good in upper 18 to 42 inches; not suitable below.	Not suitable	Good in upper 18 to 42 inches; poor below.	High water table	Low bearing strength; moderate shrink-swell potential.
Bergland (Ba)	Good	Not suitable	Not suitable	Not suitable; clay is too plastic.	Mucky surface layer must be removed; high water table; occasional ponding.	Low bearing strength; high shrink-swell potential; high risk of frost heaving.

See footnotes at end of table.

soils in Arenac County, Mich.

Soil features affecting suitability for—Continued						
Septic tank disposal field [2]	Agricultural drainage	Waterways	Farm ponds		Sprinkler irrigation [3]	Terraces and diversions
			Reservoir area	Embankment		
High water table.	High water table; tiling impractical because of sandy substratum; suitable for open ditches, but productivity seldom warrants cost of draining.	Not needed	Must be dug out.	Organic layers not suitable and sand below is too permeable.	Not needed	Not needed; soils are level.
High water table and slowly permeable substratum.	Drainage needed because of high water table; tile suitable if placed in clay but the sand in the upper part of the profile hinders installation.	No limitations	Material below a depth of 42 inches is slowly permeable.	Sandy material has rapid permeability; clay below is unstable when wet.	No limitations	Not needed, because of topography.
High water table.	Drainage needed, but is of little value unless areas are protected from flooding.	Not needed	Coarse strata are likely to cause seepage.	Variable material.	Not needed	Not needed, because of topography.
High water table.	Drainage needed because of high water table; questionable for tiling because profile is sandy.	In a few places acidity and low fertility cause problems in establishing cover.	Rapid seepage; high permeability.	Very rapid permeability.	Low water-holding capacity.	Not needed, because of topography.
High water table.	Drainage needed because of high water table; upper part of profile is sandy and not suited to tiling; suitable for open ditches.	In a few places acidity and low fertility cause problems in establishing cover.	Sand must be removed.	Sand in upper part of profile has very rapid permeability; substratum has slow or moderately slow permeability but is unstable in places.	Low water-holding capacity in the root zone.	Not needed, because of topography.
High water table; permeability of material below 18 to 42 inches is moderately slow.	High water table; upper layers are sandy and unstable when wet.	No limitations	Permeability of material below depth of 18 to 42 inches is moderately slow.	Sand in upper part of profile has rapid permeability; loamy material below a depth of 18 to 42 inches has moderately slow permeability.	Low water-holding capacity in the upper 18 to 42 inches.	Not needed, because of level topography.
Slow permeability and very high water table.	Drainage needed; tile must be closely spaced; in places outlets are difficult to locate.	Not needed	Slow seepage and permeability.	High shrink-swell potential; slow permeability.	Slow permeability; irrigation seldom needed.	Not needed; soils are level or in depressions.

TABLE 8.—*Engineering properties of*

Soil series and map symbols	Suitability as source of—				Soil features affecting suitability for—	
	Topsoil [1]	Sand [1]	Gravel [1]	Road fill	Highway location	Foundations for low buildings
Bohemian (BbA, BbB, BbC, BcA, BcB).	Poor	Poor	Not suitable	Poor (silt)	Underlying silt and sand not stable.	Low bearing strength; low shrink-swell potential; very high risk of frost heaving.
Bowers (Bd, Be)	Fair	Not suitable	Not suitable	Poor; the siltier layers are plastic.	Occasional high water table; contains plastic layers.	Low bearing strength; medium shrink-swell potential; high risk of frost heaving.
Brevort (Bf, Bn, Bo, Br, Bs).	Fair	Good to a depth of 18 to 42 inches but material is sandy and high in organic matter.	Not suitable	Sandy material is fair because of high organic content; underlying material is good.	High water table and occasional ponding.	Low bearing strength; medium shrink-swell potential in the substratum; high risk of frost heaving.
Brimley (BtA, BtB, BuA, BuB, BvA, BvB).	Fair	Poor	Not suitable	Not suitable; very fine sand and silt that lose their stability when wet.	Wet silt and very fine sand that are not stable.	Low bearing strength and shrink-swell potential; very high risk of frost heaving.
Bruce (Bw, Bx, By)	Good	Poor	Not suitable	Not suitable; very fine sand and silt that lose their stability when wet.	High water table and occasional ponding; wet silt and very fine sand that are not stable when wet.	Low bearing strength and shrink-swell potential; very high risk of frost heaving.
Burleigh (Bz)	Fair	Good to a depth of 18 to 42 inches; poor below.[4]	Not suitable	Poor; sand in upper part of profile is high in organic matter; the underlying layers contain silt and very fine sand, which are unstable when wet.	High water table and occasional ponding; unstable substratum.	Low bearing strength and shrink-swell potential; very high risk of frost heaving.
Carbondale (Ca, Td)	Good	Not suitable	Not suitable	Not suitable	Consists of organic material and is not suitable; high water table and occasional ponding.	Very low bearing strength; very high shrink-swell potential; high risk of frost heaving.

See footnotes at end of table.

soils in Arenac County, Mich.—Continued

Soil features affecting suitability for—Continued						
Septic tank disposal field [2]	Agricultural drainage	Waterways	Farm ponds		Sprinkler irrigation [3]	Terraces and diversions
			Reservoir area	Embankment		
Moderate permeability; moderate seepage; calcareous in lower layers.	Not needed	Subject to erosion.	Subject to moderate seepage.	Low stability; moderate seepage.	Topography unfavorable in many places.	Soil properties favorable; no limitations.
High water table.	Needed in places to lower water table; suited to tiling.	Subject to erosion.	Moderately slow seepage and permeability.	Moderate shrink-swell potential; moderately slow permeability.	Moderately slow permeability.	Soil properties favorable, but seldom needed, because of level topography.
High water table.	Drainage needed to lower water table and remove standing water; tiling is hindered by sand in the upper part of the profile; tile must be placed in the substratum; outlets difficult to locate in many places because of topography.	Not needed	Favorable in depressional areas; substratum has moderately slow permeability.	Sand in upper part of profile is poor because of high content of organic matter and rapid permeability; underlying material compacts well.	Poor natural drainage.	Not needed, because of level topography.
High water table.	Drainage required to lower water table; lenses of very fine sand hinder placing of tile; ditch banks are unstable.	No limitations	Moderate seepage and permeability.	Unstable silt and very fine sand	Limited natural drainage.	Soil properties favorable; no limitations.
High water table.	Drainage required because of high water table and ponding; lenses of very fine sand hinder placing of tile; ditch banks are unstable.	No limitations	Favorable in depressional areas; subject to moderate seepage; permeability is moderate.	High organic content; unstable silt and very fine sand.	Poor natural drainage.	Not needed, because of level topography.
High water table.	Drainage required because of high water table and ponding; profile is sandy throughout and the sand hinders placing of tile.	High water table.	Favorable in depressional areas.	High organic content and rapid permeability make the material unsuitable.	Poor natural drainage.	Not needed; soils are nearly level or in depressions.
High water table.	Open ditch drainage lowers water table effectively.	Not needed	Moderate seepage; mucky.	Consists of organic material and is not suitable.	Artificial drainage must be provided.	Not needed; soils are level.

TABLE 8.—*Engineering properties of*

Soil series and map symbols	Suitability as source of—				Soil features affecting suitability for—	
	Topsoil [1]	Sand [1]	Gravel [1]	Road fill	Highway location	Foundations for low buildings
Charity (Ch)	Good	Not suitable	Not suitable	Fair; clay becomes unstable when wet.	High water table and occasional ponding; surface is slippery when wet; clay makes an unstable roadbed.	Medium bearing strength; high shrink-swell potential; high risk of frost heaving.
Dawson (Dg)	Poor because of acidity.	Good below organic layers.[4]	Not suitable	Organic material not suitable; underlying sand is good.	High water table and ponding; organic layers must be removed.	Material is unstable; has high compressibility and very low bearing strength.
Deford (Dm, Dn)	Fair	Poor; in places contains pockets of sand that can be used.	Not suitable	Fair to good; surface layer is high in organic matter; fine sand strata unstable in places.	High water table and occasional ponding; fine sand strata unstable in places.	Medium bearing strength; low shrink-swell potential; very high risk of frost heaving.
Duel (DuA, DuB, DuC)	Poor	Not suitable	Good; consists of crushed limestone.	Not suitable; shallow to bedrock; in places bedrock is shale.	Shallow to bedrock and bedrock is likely to interfere with cuts and fills.	High bearing strength; very low shrink-swell potential; very low risk of frost heaving.
Eastport (AeB, ErB, ErC, ErC2, ErD, ErD2, ErE2, ErF, EsC, EtB).	Poor	Good but contains pockets and lenses of poor material.	Poor	Good	Low water table; possible blowing in cuts.	High bearing strength; low shrink-swell potential; very low risk of frost heaving.
Edwards (Eu)	Good	Not suitable	Not suitable but a possible source of marl.	Not suitable; consists of organic material over marl.	High water table; ponding; poor stability.	Very low bearing strength; high shrink-swell potential; high risk of frost heaving.
Epoufette (Ew)	Fair to a depth of 10 inches.	Good in upper 18 to 42 inches.[4]	Good but contains strata of finer material.[4]	Good, but surface layer is highly organic.	High water table but solid bed.	High bearing strength; subject to piping; low shrink-swell potential; risk of frost heaving.
Essexville (Ex)	Fair to a depth of 10 inches.	Fair to a depth of 18 to 42 inches.	Not suitable	Fair; sandy layers are high in organic matter.	High water table; in a few places surface is mucky and ponded.	Low bearing strength; very low shrink-swell potential in the upper part of the profile but medium in the lower part; high risk of frost heaving.

See footnotes at end of table.

soils in Arenac County, Mich.—Continued

Soil features affecting suitability for—Continued						
Septic tank disposal field [2]	Agricultural drainage	Waterways	Farm ponds		Sprinkler irrigation [3]	Terraces and diversions
			Reservoir area	Embankment		
High water table and slow seepage.	Drainage required to lower water table; tile can be used if outlets are available.	Not needed	Slow seepage and permeability.	Compacts well; clay is likely to be unstable when wet.	Poor natural drainage.	Not needed, because of level topography.
High water table.	Drainage needed to control water table; open ditches can be used to provide drainage but tile drains are not suited.	Not needed	Favorable in depressional areas; rapidly permeable substratum.	Not suitable; consists of organic material and the underlying sand has very rapid permeability.	Not suitable; acid peat.	Not needed; soils are level and in depressions.
High water table.	Drainage needed to control water table; profile is sandy, and open ditches are preferred to tile drains.	Not needed	Rapid permeability.	Unsuitable; material has high organic content and is rapidly permeable.	Poor natural drainage.	Not needed, because of topography.
Too shallow to install a tank.	Not needed	Not needed	Shallow to bedrock and is on knolls.	Unsuited for embankments because soil material is sandy and rocky.	Low water-holding capacity.	Hard rock at a depth of 18 to 42 inches.
Very rapid permeability.	Not needed	Not needed because runoff is slow.	Very rapid permeability.	Very rapid permeability.	Low water-holding capacity.	Not needed; use for farm crops is limited.
High water table.	Drainage needed to lower water table; marl at depth of 18 to 42 inches hinders drainage in places.	Not needed	Dugout ponds are successful in places.	Organic material is unstable; marl below hardens when dry.	Not needed because soil has high water-holding capacity.	Not needed; soil is level or in depressions.
High water table but rapid seepage.	Drainage needed to lower water table; sand and gravel make placing of tile drains difficult.	Not needed	Material very rapidly permeable.	Very rapid permeability; rapid seepage.	Generally not needed because water table is high; good if drained.	Not needed; soil is nearly level.
High water table.	Drainage can be done by tiling to correct high water table if tiles are placed in substratum; the sand overlying the substratum hinders placing of tile.	Not needed	Substratum has moderately slow permeability.	Sandy material is rapidly permeable; substratum compacts well.	Seldom needed because of high water table.	Not needed; soil is nearly level.

TABLE 8.—*Engineering properties of*

Soil series and map symbols	Suitability as source of—				Soil features affecting suitability for—	
	Topsoil [1]	Sand [1]	Gravel [1]	Road fill	Highway location	Foundations for low buildings
Fresh water marsh (Fm)	Good but inaccessible.	Not suitable	Not suitable	Not suitable; mucky and unstable.	Unstable and frequently under water.	Unstable material; high water table.
Gladwin (Gm, GnB)	Poor	Good	Good	Good	Periodically high water table but solid bed.	High bearing strength; low shrink-swell potential; high risk of frost heaving.
Gravel and sand pits (Gp).[6]						
Grayling (Gr)	Poor	Good	Poor	Good	Solid bed; blowing possible in places in cuts.	High bearing strength; very low shrink-swell potential; very low risk of frost heaving.
Greenwood (Dg; mapped only with Dawson soils).	Poor because of acidity.	Good below organic layers.[4]	Not suitable	Organic material is not suitable; underlying sand is good.	High water table; ponding; organic layers must be removed.	Unstable material; high compressibility; very low bearing strength.
Gullied land (Gu)[6]						
Hettinger (Hc, Hg, Hn).	Good	Not suitable	Not suitable	Fair to poor; silty layers are unstable in places.	High water table; silty layers make an unstable roadbed.	Low bearing strength; medium shrink-swell potential; high risk of frost heaving.
Ingalls (IgA, IgB)	Fair in top few inches; poor below.	Good to a depth of 18 to 42 inches.	Not suitable	Sand in upper part of the profile is fair; silt and very fine sand in substratum is unstable when wet.	Periodically high water table; silty substratum is unstable when wet.	Medium bearing strength; low shrink-swell potential; very high risk of frost heaving.
Iosco (ImA, ImB, IoA, IoB, IrB, NrE).	Fair in top few inches; poor below.	Good to a depth of 18 to 42 inches.	Not suitable	Sandy material is good; substratum is fair.	Periodically high water table.	Low bearing strength; subject to piping in places; very low shrink-swell potential; medium risk of frost heaving.
Isabella (IuA, IuB, IuC, IuD, IuF, IwA, IwB, IwB2, IwC, IwC2).	Poor	Not suitable	Not suitable	Good	No limitations except for a few seep spots on hillsides.	Medium bearing strength; medium shrink-swell potential; low risk of frost heaving.

See footnotes at end of table.

soils in Arenac County, Mich.—Continued

Soil features affecting suitability for—Continued						
Septic tank disposal field [2]	Agricultural drainage	Waterways	Farm ponds		Sprinkler irrigation [3]	Terraces and diversions
			Reservoir area	Embankment		
High water table.	Not suited to agriculture.	Not needed.	Can be used as natural wildlife marshes without impoundment.	Material is not stable.	Not needed.	Not suited to farm crops.
Water table is sometimes a problem.	Fluctuating water table; hard to install tile drains because of sand and gravel.	Not needed, because of rapid infiltration.	Rapid permeability; high loss from seepage.	Rapid seepage.	Low water-holding capacity; good if drained.	Generally not needed because of topography.
Good.	Not needed.	Not needed, because of rapid infiltration.	Excessive seepage.	Very rapid permeability; subject to erosion.	Low water holding capacity; poorly suited to agriculture.	Erosion hazard; use for farm crops is limited.
High water table.	Drainage needed for control of water table; open ditches can be used to lower the water table, but tile drains are not suited.	Not needed.	Favorable in depressions; substratum highly permeable.	Organic material not suitable; underlying sand has very rapid permeability.	Acid peats; irrigation not warranted.	Not needed; soils are level and in depressions.
High water table and moderately slow permeability.	Drainage needed to lower the water table; tile drains satisfactory.	No limitations.	Good compaction; moderately slow permeability; occurs in natural depressions.	Good compaction; silty lenses are unstable in a few places.	Poor natural drainage.	Not needed; soils are level and in depressions.
High water table.	Periodically high water table; difficult to install tile drains because of sand, fine sand, and silt in the profile.	No limitations.	Substratum has moderate permeability.	Sandy layers are rapidly permeable; silty substratum tends to be unstable.	Natural drainage must be improved.	Soil properties favorable; no limitations.
High water table.	Periodically high water table; sand in the upper part of the profile somewhat hinders tiling; tile should be placed in the substratum.	No limitations.	Substratum compacts well, but soils are on small knolls in many places.	Sandy layers are rapidly permeable; substratum compacts well and has moderately slow permeability.	No limitations if adequate drainage is provided.	Soil properties favorable; no limitations.
Moderately slow permeability.	Not needed.	Slopes are steep in many places; moderate hazard of erosion.	Material compacts well but soils are sloping.	Good compaction; moderately slow permeability.	Erosion hazard on slopes of more than 12 percent.	No limitations on slopes of less than 12 percent, but erosion is a hazard on steeper slopes.

TABLE 8.—*Engineering properties of*

Soil series and map symbols	Suitability as source of—				Soil features affecting suitability for—	
	Topsoil [1]	Sand [1]	Gravel [1]	Road fill	Highway location	Foundations for low buildings
Kawkawlin (Br, KaA, KaB).	Fair	Not suitable	Not suitable	Fair	Risk of frost heaving in places; occasional high water table.	Medium bearing strength; medium shrink-swell potential; high risk of frost heaving.
Kent (KnA, KnB, KnC)	Fair	Not suitable	Not suitable	Fair to poor; clay unstable when wet.	Steep slopes and seep spots in places.	Low bearing strength; high shrink-swell potential; medium risk of frost heaving.
Lacota (La, Lb, Lc)	Good, especially the silty clay loam.	Good below a depth of 18 inches.[4]	Pockets of good gravel at a depth below 18 inches.[4]	Upper 18 inches of material is unstable and is high in organic matter; substratum is good.	High water table; content of organic matter in upper 18 inches of profile is high.	Medium bearing strength; medium shrink-swell potential; high risk of frost heaving.
Lake beach (Lk)	Not suitable	Fair; pockets of usable material.	Good gravel in pockets.	Good	Soil properties are generally favorable.	Variable
Linwood (Lm)	Good	Not suitable	Not suitable	Upper 12 to 42 inches is not suitable; substratum is fair to good.	Organic layers are unstable; high water table; occasional ponding.	Very low bearing strength; very high shrink-swell potential; medium risk of frost heaving.
Mancelona (MaA, MaB).	Poor	Good but mixed with gravel.	Good but mixed with sand.	Good	Slope is only limitation.	High bearing strength; low shrink-swell potential; very low risk of frost heaving.
Manistee (MdA, MdB)	Poor	Good to a depth of 18 to 42 inches.	Not suitable	Sandy material is good; substratum is poor because of high plasticity.	Plastic or unstable substratum at a depth of 18 to 42 inches.	Medium bearing strength; low shrink-swell potential in upper 18 to 42 inches of material and high below that depth; low risk of frost heaving.

See footnotes at end of table.

soils in Arenac County, Mich.—Continued

Soil features affecting suitability for—Continued						
Septic tank disposal field [2]	Agricultural drainage	Waterways	Farm ponds		Sprinkler irrigation [3]	Terraces and diversions
			Reservoir area	Embankment		
Moderately slow permeability and high water table.	Periodically wet but wetness can be corrected by tiling; short slopes likely to be a problem in placing the tile; in places a saturated zone is above the layer of limy clay loam.	Soil properties suitable; no limitations.	Moderately slow permeability.	Good compaction; moderately slow permeability.	Soil properties suitable; short slopes.	Soil properties suitable; no limitations.
Slow permeability.	Not needed except in a few seep spots.	No limitations	Material is compact and slowly permeable; soils are on knolls.	Good compaction; clay tends to lose stability in a few places; slow permeability.	Slow permeability and infiltration.	No limitations on slopes of less than 12 percent, but erosion is a hazard on steeper slopes.
High water table.	Gravelly substratum hinders tiling; water drains laterally into open ditches for a considerable distance.	Not needed; water drains over the surface readily.	Very rapidly permeable sand and gravel at a depth of 18 to 42 inches.	Very rapidly permeable substratum.	No limitation if water table is controlled.	Not needed, because soils are nearly level.
Water table at variable depths.	Not used for farm crops.	Not needed	Very rapid permeability and short, steep slopes make areas unsuitable.	Very permeable	Not suited to farm crops.	Not suited to farm crops.
High water table.	Not generally drained for use for farm crops; tile must be placed in substratum and outlets are difficult to locate.	Not needed	Substratum compacts well if organic covering is removed.	Substratum compacts well and has moderately slow permeability.	Not generally needed because of high water table.	Not needed; soil is nearly level and in depressions.
Rapid permeability.	Not needed	Not needed, because runoff is slow.	Rapid permeability; excessive seepage.	Rapid permeability.	Moderately low water-holding capacity.	Soil properties are suitable; no limitations.
Slowly permeable substratum.	Not needed	No limitations	Must be excavated below the depth of the sand; slowly permeable substratum.	Sandy material has very rapid permeability; clay below is plastic and unstable in places.	Low water-holding capacity in root zone; saturated zone likely along top of clay.	No limitations on slopes of less than 12 percent but erosion is a hazard on steeper slopes.

TABLE 8.—*Engineering properties of*

Soil series and map symbols	Suitability as source of—				Soil features affecting suitability for—	
	Topsoil [1]	Sand [1]	Gravel [1]	Road fill	Highway location	Foundations for low buildings
Markey (Me)	Good	Fair below a depth of 12 to 42 inches.	Not suitable	Organic layers are not suitable; underlying sand is good.	Organic material in surface soil is not suitable for roadbeds; high water table and occasional ponding.	Unstable organic material in the upper 12 to 42 inches; low volume change.
Maumee (Mk, Mm, Mn).	Good	Fair below organic layers.[4]	Not suitable	Organic layers are not suitable; underlying sand is good.	High water table; highly organic layers are not suitable for roadbeds.	High bearing strength; low shrink-swell potential; high risk of frost heaving.
Menominee (MoA, MoB, MoC, MoD, MoE, MoF2, MsA, MsB, MsC).	Poor	Good to a depth of 18 to 42 inches.	Not suitable	Sandy material is good; substratum is fair to good and packs well.	Sandy material erodes in cuts in places.	Medium bearing strength; low shrink-swell potential in upper 18 to 42 inches but medium below that depth; low risk of frost heaving.
Nester (NcC3, NcD3, NcE3, NcF3, NfA, NfB, NfB2, NfC, NfC2, NfD, NfD2, NfE, NfE2, NfF, NfF2, NmB, NoB, NrE).	Fair	Not suitable	Not suitable	Good	No limitations on gentle slopes; the steeper slopes are short.	Medium bearing strength; medium shrink-swell potential; low risk of frost heaving.
Pickford (Pc, Pd, Pk, Pm).	Good but sticky and hard to handle.	Not suitable	Not suitable	Not suitable because of high plasticity of clay.	High water table; plastic clay makes an unstable roadbed.	Low bearing strength; high shrink-swell potential; high risk of frost heaving.
Pinconning (Ps)	Fair	Fair to a depth of 18 to 42 inches; high in organic matter.	Not suitable	Sand is fair; underlying clay is plastic and unstable.	High water table; plastic clay substratum.	Low bearing strength; high shrink-swell potential; high risk of frost heaving.
Richter (RaA, RbA, RcA, RcB, Re).	Fair	Fair; stratified	Poor; occasional pockets of fair gravel.	Good	Periodically high water table.	Low bearing strength; low shrink-swell potential; high risk of frost heaving.
Rifle (Rf)	Poor because of acidity.	Not suitable	Not suitable	Not suitable; consists of organic material.	High water table; organic material is not suitable as a roadbed.	Very low bearing strength; very high shrink-swell potential; medium risk of frost heaving.

See footnotes at end of table.

soils in Arenac County, Mich.—Continued

Soil features affecting suitability for—Continued						
Septic tank disposal field [2]	Agricultural drainage	Waterways	Farm ponds		Sprinkler irrigation [3]	Terraces and diversions
			Reservoir area	Embankment		
High water table.	Drainage needed to lower high water table; sand in the substratum hinders tiling.	Not needed	Substratum has very rapid permeability.	Organic layers not suitable; underlying sand, very rapidly permeable.	High water table.	Not needed; soil is level.
High water table.	Drainage needed to correct high water table, but sandy substratum hinders placing of tile.	Not needed	Substratum has very rapid permeability.	Organic layers are high in organic matter; substratum is excessively permeable.	High water table.	Not needed; soil is nearly level.
Substratum restricts seepage.	Not needed	No limitations	Sandy material has very rapid permeability; substratum generally packs well.	Sandy material has very rapid permeability.	Low water-holding capacity in root zone.	No limitations on slopes of less than 12 percent.
Moderately slow permeability.	Not needed, but temporary saturation in places along the top of the subsoil.	Soil properties are suitable; no limitations.	Low seepage; material compacts well; topography not favorable.	Slow seepage; material compacts well.	No limitations	No limitations on slopes of less than 12 percent, but erosion is a hazard on steeper slopes.
High water table and slow permeability.	Drainage needed to lower water table; tile provides satisfactory drainage but must be closely spaced.	Not needed	Slow permeability.	Clay is plastic and unstable when wet; high shrink-swell potential.	High water table.	Not needed; soils are level or nearly level.
High water table and slowly permeable substratum.	Drainage needed to lower water table; sandy upper part of the profile hinders the installation of tile, which must be laid in the underlying clay.	Not needed	In depressions; slowly permeable substratum.	Sand in upper part of profile has high permeability; clay below has high shrink-swell potential, is plastic, and is unstable.	High water table.	Not needed; soils are nearly level and in low areas.
High water table.	Drainage needed to lower water table; material is sandy and hinders placing of tile.	No limitations	Moderately rapid permeability.	Moderately rapid permeability.	No limitations	No limitations.
High water table.	Generally not drained because of high acidity.	Not needed	Dugout ponds feasible in places.	Consists of organic material and not suited.	Not needed	Not needed; soil is nearly level.

TABLE 8.—*Engineering properties of*

Soil series and map symbols	Suitability as source of—				Soil features affecting suitability for—	
	Topsoil [1]	Sand [1]	Gravel [1]	Road fill	Highway location	Foundations for low buildings
Roscommon (Aw, Bs, EtB, Rg, Rh, Rk, RmB, Te).	Fair	Fair but upper part is high in organic matter.[4]	Not suitable	Good	High water table; occasional ponding.	High bearing strength; low shrink-swell potential; medium risk of frost heaving.
Rousseau (RoA, RoB, RoD).	Poor	Fair; consists of stratified sand.	Not suitable	Good	Short, steep slopes in places; cuts likely to erode in places.	Medium bearing strength; low shrink-swell potential; medium risk of frost heaving.
Rubicon (AeB, Ax, ErB, ErC, ErC2, ErD, ErD2, ErE2, ErF, EsC, EtB, IrB, NrE, RmB, RsB, RsC, RsD, RsE, RsF, RuB, RuC, RvB).	Poor	Good	Not suitable	Good	Steep slopes in places; cuts likely to erode in places.	High bearing strength; very low shrink-swell potential; very low risk of frost heaving.
Rubicon, moderately fine substratum (RpB, RpC, RtB, RtC, RtD).[7]	Poor	Good to a depth of 42 to 60 inches.	Not suitable	Sand is good; substratum is fair to poor, depending on clay content.	Sand; likely to erode in places in cuts.	High bearing strength; piping in places; very low shrink-swell potential; low risk of frost heaving.
Rudyard (RyA)	Good	Not suitable	Not suitable	Poor; clay is unstable and plastic.	Periodically high water table; clay makes unstable roadbed.	Low bearing strength; high shrink-swell potential; high risk of frost heaving.
Saganing (Sa)	Good	Good below a depth of 18 to 42 inches.[4]	Fair gravel in places in pockets.[4]	Good in lower layers; upper layers are high in organic matter.	High water table	Medium bearing strength and shrink-swell potential; high risk of frost heaving.
Saugatuck (Sb, Sc)	Poor	Good below hardpan.	Not suitable	Good	High water table	High bearing strength; low shrink-swell potential.
Selkirk (SdA, SeA, SeB, SfA, SkA, SlA).	Good	Not suitable	Not suitable	Fair; high in clay but compacts well.	Periodically high water table; clay is unstable in places.	Low bearing strength; high shrink-swell potential; high risk of frost heaving.

See footnotes at end of table.

soils in Arenac County, Mich.—Continued

Soil features affecting suitability for—Continued						
Septic tank disposal field [2]	Agricultural drainage	Waterways	Farm ponds		Sprinkler irrigation [3]	Terraces and diversions
			Reservoir area	Embankment		
High water table.	Drainage needed; tile drains not practical because soil material is sandy.	Not needed; runoff is slight and relief is fairly level.	Very rapid permeability	Very rapid permeability.	High water table.	Not needed; soils are mostly nearly level or in depressions.
Rapid permeability.	Not needed	No limitations	Rapid permeability; in sloping areas.	Rapid permeability.	Low water-holding capacity.	No limitations.
Very rapid permeability.	Not needed	Not needed; little runoff because of rapid intake of water.	Very rapid permeability; seepage on slopes.	Very rapid permeability.	Low water-holding capacity.	No limitations on slopes of less than 12 percent, but hazard of erosion on steeper slopes.
Substratum restricts seepage in places.	Not needed	Cuts erode readily; because of acidity and low fertility need to establish cover in many places.	Sandy material has rapid permeability; pond must be dug into substratum.	Sandy material has rapid permeability; substratum may compact well or may be too plastic.	Low water-holding capacity in root zone.	No limitations on slopes of less than 12 percent, but erosion is a hazard on steeper slopes.
High water table and slow permeability.	Drainage needed to lower water table; tile drains are effective but must be closely spaced.	No limitations	Slow permeability.	Slow permeability; plastic clay unstable when wet.	Slow permeability and high water-holding capacity.	No limitations.
High water table.	Drainage needed to lower water table; placing of tile is hindered by sandy substratum; ditches provide effective drainage.	Not needed; runoff is very slow to ponded.	Very permeable substratum at a depth of 18 to 42 inches.	Moderate permeability.	High water table.	Not needed; soils are nearly level.
High water table.	Drainage is needed but seldom accomplished; placing of tile is hindered because the soils are sandy and have a hardpan.	Not needed; runoff is very slow.	Rapid permeability.	Rapid permeability causes seepage.	Hardpan restricts infiltration.	Not needed; soils are fairly level.
High water table and slow permeability.	Drainage needed to lower water table, and tile drains are practical to use; occasional saturation along the top of the B horizon, especially in the fine sandy loam and loamy sand.	No limitations	Slow permeability; good compaction.	Slow permeability; low seepage; good compaction.	No limitations	No limitation because of soil properties; slopes short and choppy in places.

TABLE 8.—*Engineering properties of*

Soil series and map symbols	Suitability as source of—				Soil features affecting suitability for—	
	Topsoil [1]	Sand [1]	Gravel [1]	Road fill	Highway location	Foundations for low buildings
Sims (Sm, Sn, Sp, Sr)	Good	Not suitable	Not suitable	Fair; surface layers high in organic matter.	High water table; surface layers high in organic matter.	Medium bearing strength and shrink-swell potential; high risk of frost heaving.
Stone quarries (Su).[6]						
Summerville (SvA, SvB).	Poor	Not suitable	Not suitable; underlying bedrock can be crushed for road gravel.	Poor but fair crushed bedrock.	Less than 18 inches deep to bedrock.	High bearing strength; low shrink-swell potential; low risk of frost heaving.
Tawas (Ta, Tb, Tc, Td, Te).	Good	Good below a depth of 18 to 42 inches.[4]	Not suitable	Organic layers are not suitable; underlying sand is good.	High water table; organic layers are not suitable as a road base.	Low bearing strength in upper 12 to 42 inches and high below; very high shrink-swell potential, medium risk of frost heaving.
Tobico (Tf, Tg)	Poor	Good [4]	Not suitable	Good	High water table and occasional ponding.	High bearing strength; low shrink-swell potential; high risk of frost heaving.
Tonkey (Th, Tk, Tm)	Good	Poor	Not suitable	Good	Periodically high water table.	Low bearing strength and shrink-swell potential; high risk of frost heaving.
Twining (TnA, TsA, TsB, TwA, TwB).	Good	Not suitable	Not suitable	Fair	Occasional high water table.	Medium bearing strength and shrink-swell potential; high risk of frost heaving.
Ubly (IuA, IuB, IuC, IuD, IuF, IwA, IwB, IwB2, IwC, IwC2; mapped only with Isabella soils).	Fair	Good in upper 18 to 42 inches; not suitable below.	Not suitable	Good in upper 18 to 42 inches; poor below.	Subject to blowing in exposed areas.	Low bearing strength; moderate shrink-swell potential.
Wainola (WaA, WaB)	Fair	Poor; sand is stratified.	Not suitable	Good	Occasional high water table.	Medium bearing strength; low shrink-swell potential; very high risk of frost heaving.

See footnotes at end of table.

soils in Arenac County, Mich.—Continued

Soil features affecting suitability for—Continued						
Septic tank disposal field [2]	Agricultural drainage	Waterways	Farm ponds		Sprinkler irrigation [3]	Terraces and diversions
			Reservoir area	Embankment		
High water table.	Drainage needed; tile drains work well on the broad plains; outlets are a problem in closed depressions.	Drainage needed only where soils occur in natural waterways; no limitations in such areas.	Good compaction; some areas in depressions; many small areas can be flooded with little excavation.	Good compaction; moderately slow permeability.	High water table.	Not needed; soils are nearly level.
Shallow to bedrock.	Not needed	Shallow to bedrock.	Cannot be excavated because depth to bedrock is shallow.	Not suitable	Low water-holding capacity.	Shallow to bedrock.
High water table.	Drainage needed to lower water table; open ditches can be used; the sandy substratum hinders placing of tile drains.	Not needed; runoff is very slow to ponded.	Substratum has very rapid permeability.	Organic layers are unsuitable; substratum has very rapid permeability.	High water table.	Not needed, because of level topography.
High water table.	Drainage needed to lower water table; tile drains impractical because the soils are sandy.	Not needed; runoff is slow to ponded.	Rapid permeability.	Rapid permeability.	High water table.	Not needed; soils are nearly level.
High water table.	Drainage needed to lower water table; soils are sandy and hinder placing of tile drains.	Not needed because of very slow runoff.	Moderately rapid permeability.	Moderately rapid permeability.	High water table.	No limitations.
High water table.	Drainage needed to lower water table; occasional lenses of sand or gravel hinder placing of tile in some areas.	No limitations	Moderate permeability; a few sandy or gravelly lenses cause seepage in places.	Good compaction in lower part; sandy upper layers not suitable.	No limitations	No limitations.
Moderately slow permeability at a depth below 18 to 42 inches.	Not needed	No limitations	Material below depth of 18 to 42 inches has moderately slow permeability.	Sandy layers have rapid permeability; material below a depth of 18 to 42 inches has moderately slow permeability.	Low water-holding capacity in the upper 18 to 42 inches.	Sandy material and subject to erosion.
High water table.	Drainage needed to lower water table; soils are sandy and placing of tile is difficult.	Not needed, because of slow runoff.	Rapid permeability.	Rapid permeability.	Moderately low water-holding capacity.	No limitations.

TABLE 8.—*Engineering properties of*

Soil series and map symbol	Suitability as source of—				Soil features affecting suitability for—	
	Topsoil [1]	Sand [1]	Gravel [1]	Road fill	Highway location	Foundations for low buildings
Warners (Wk)	Fair; in places good source of marl.	Not suitable	Not suitable	Not suitable	Consists of organic materials, which make an unsuitable roadbed.	Very unstable; very high shrink-swell potential and risk of frost heaving.
Willette (Wm)	Good	Not suitable	Not suitable	Organic layers are not suitable; underlying clay is plastic and unstable when wet.	Organic layers make an unsuitable roadbed; underlying clay is unstable.	Low bearing strength; very high shrink-swell potential; medium risk of frost heaving.
Wisner (Wn, Wo, Ws)	Good	Not suitable	Not suitable	Fair; surface layer is high in organic matter.	High water table; surface layer is high in organic matter.	Medium bearing strength and shrink-swell potential; high risk of frost heaving.

[1] The Field Manual of Soil Engineering, 4th edition, published by the Michigan State Highway Department (*4*), was used as a guide in assembling this information.

[2] Terms used to characterize the permeability of the soils have the following ranges in hydraulic conductivity:

	Inches per hour
Very rapid	10. 0+
Rapid	5. 0 to 10. 0
Moderately rapid	2. 5 to 5. 0
Moderate	0. 8 to 2. 5
Moderately slow	0. 2 to 0. 8
Slow	0. 05 to 0. 2
Very slow	0. 00 to 0. 05

[3] Estimates of available water capacity are based on the following ranges in moisture content, between ⅓ and 15 atmospheres tension,

Factors that affect the suitability of the soils for agricultural drainage are also given in table 8. Some of the factors are the texture of the soil, the rate of water movement into and through the soil, depth to a restricting layer or to bedrock, depth to the water table, and the position of the soil on the landscape.

Also considered in the table are features that affect the layout and construction of waterways, the establishment of vegetation in the waterways, the continued growth of the plants, and maintenance of the waterways. Some of the main factors affecting the suitability of the soils for this purpose are the reaction of the soils, the permeability, the fertility, and the hazard of erosion.

In determining the ratings of the suitability of a soil for a farm pond, the entire soil profile is considered for the reservoir area and for the embankment material unless otherwise specified. The ratings for reservoir areas are for undisturbed soils, but factors of soils that have been disturbed were considered in making the ratings for embankments. Features that affect the suitability of the soils for reservoirs and embankments are the content of organic matter, permeability, depth to bedrock, shrink-swell potential, ground water level, and strength and stability.

The main factors considered in rating the soils as to their suitability for irrigation are the water-holding capacity and the rate at which water moves into a soil. Also important are depth to the water table, depth to soil material that restricts growth of roots, and topography.

Residential development.—Some features important to development of sites for residences already have been discussed, such as suitability of the soils for domestic sewage disposal systems. Further information that needs to be considered is discussed in the paragraphs that follow.

Soils that are somewhat poorly drained or that are poorly drained, that have a seasonal high water table, or that are slowly permeable make poor construction sites. Sewage disposal systems do not function properly in such soils. For a sewage disposal system to function properly, a percolation rate of 60 minutes per inch or less—the equivalent of a permeability rate of 1 inch per hour—is required. Permeability rates for the soils of Arenac County are given in table 7, and drainage of the soils is given in the section "Descriptions of the Soils."

soils in Arenac County, Mich.—Continued

Soil features affecting suitability for—Continued						
Septic tank disposal field [2]	Agricultural drainage	Waterways	Farm ponds		Sprinkler irrigation [3]	Terraces and diversions
			Reservoir area	Embankment		
High water table.	Drainage needed to lower water table; open ditches preferred to tile drains.	Not needed	Variable substratum.	Not suitable; consists of organic material.	High water table.	Not needed; soil is level or in depressions.
High water table and slowly permeable substratum.	Drainage needed; tile drains must be installed in clay substratum; open ditches provide drainage in places.	Not needed	Substratum is slowly permeable.	Organic materials are unsuitable; underlying clay is plastic and unstable.	High water table.	Not needed; soil is level or in depressions.
High water table and moderately slow seepage.	Drainage needed to lower water table; well suited to tile drains.	No limitations	Moderately slow permeability; good compaction.	Moderately good permeability; good compaction.	High water table.	Not needed; soils are level.

to a depth of 60 inches or to a root-restricting layer:

	Inches		Inches
Very high	12+	Low	3 to 6
High	9 to 12	Very low	0 to 3
Medium	6 to 9		

[4] The sand and gravel from areas of these soils must be removed from below the water table, and much highly organic material must be removed to reach the sand or gravel.

[5] Shown as Arenac sand in material published by the Michigan Experimental Station.

[6] Miscellaneous land type; on-site investigation needed to determine properties.

[7] Shown as Melita loamy sand or sand in material published by the Michigan Experimental Station.

A dry basement is difficult to construct in soils that are wet and slowly permeable. The well-drained sandy loams and loamy sands of the Mancelona, Rousseau, and Ubly series are the most favorable in the county for use as residential sites. The well-drained, very sandy soils, such as the Eastport, Grayling, and Rubicon, are also suited, but they are droughty and it is difficult to establish and maintain shrubs and lawns on them. Watering shrubs and lawns regularly and topdressing such areas with loamy soil makes such soils less droughty.

Soils that have low bearing strength, such as the Bohemian and Brimley soils, are not suitable for residences, particularly those of more than one story. The walls of basements in these soils are likely to crack and the foundations to settle. The risk of frost heaving is fairly high on the somewhat poorly drained and the poorly drained, finer-textured soils, such as the Brimley, Bruce, Kawkawlin, and Selkirk. Paved sidewalks, driveways, and floors of garages or carports are likely to be damaged by frost heaving on these soils unless a foot or more of coarse-textured material is placed below the paved areas. Also, soils that have a high shrink-swell potential are unsuitable for foundations and structures. The shrink-swell potential of the Arenac County soils is shown in table 7, and the suitability of the soils for foundations is shown in table 8.

Alluvial soils on flood plains of streams in the county are subject to flooding and should not be used as sites for residences.

Recreational uses.—Many of the features that make soils suitable for recreation are shown in tables in this section or are discussed elsewhere in the report. Slope, drainage, permeability, stability of the soil, depth to water table, frequency of flooding, ability to grow vegetation, suitability for highways, and hazard of erosion are factors that affect the suitability of a site for recreation. Of these, the slope, drainage, frequency of flooding, hazard of erosion, and the ability of the soils to grow various kinds of plants are given in the "Descriptions of the Soils." Permeability and depth to water table are shown in table 7. The limitations to the use of the soils for highways and as drainage fields for septic tanks are given in table 8. Many areas of alluvial soils on flood plains of streams in the county provide suitable sites for some kinds of recreational use, even though they are subject to flooding.

For other information on how to use and treat the soils for recreational purposes, see the local office of the Soil Conservation Service or the county agent.

Formation, Classification, and Morphology of Soils

In this section the factors that affect the formation, classification, and morphology of the soils are discussed. Following this discussion each soil series in the county is described and a soil profile typical of that series is given.

Factors of Soil Formation

Soil is formed by weathering and other processes that act on parent material. The characteristics of the soil at any given point depend on (1) parent material; (2) climate; (3) plant and animal life; (4) relief and drainage; and (5) time, or age.

The factors of soil formation are so closely interrelated in their effects that few generalizations can be made about one factor unless conditions are specified for the other four factors.

Parent materials

The parent materials of the soils of Arenac County were deposited by glaciers or by melt water from the glaciers. These glaciers covered the county from about 10,000 to 12,000 years ago. The parent materials, though of common glacial origin, vary greatly within a small area. Their properties also vary greatly, depending on how the parent materials were deposited. The dominant parent materials in the county are glacial till, outwash deposits, lacustrine deposits, alluvium, and organic material.

Glacial till is material laid down directly by glaciers with a minimum of water action. It consists of particles of different sizes that are mixed together. The small pebbles in glacial till have sharp corners, indicating that they have not been worn by water washing. The glacial till in Arenac County is calcareous and firm. Its texture is loam, sandy clay loam, clay loam, or clay. An example of soils formed in glacial till are those of the Nester series. These soils typically are moderately fine textured and have well-developed structure.

Outwash deposits consist of material laid down by running water from melting glaciers. The size of the particles that make up outwash material varies according to the speed of the stream of water that carried them. When the water slows down, all coarse particles are deposited. Fine particles, such as silt and clay, can be carried by quite slowly moving water. Outwash deposits generally consist of layers of particles of similar size, and sand, gravel, and other coarse particles are dominant. The Rubicon soils, which are typically coarse textured, formed in deposits of outwash sand.

Lacustrine deposits are made up of material laid down under still, or ponded, glacial melt water. Because the coarser fragments drop out of moving water as outwash, only the finer particles, such as silt and clay, remain to settle out in still water. Lacustrine deposits are silty or clayey in texture. The Bowers soils, formed in lacustrine deposits, are typically moderately fine textured.

Alluvium is material deposited by floodwaters of present streams in recent time. This material varies in texture, according to the speed of the water from which it was deposited. The alluvium deposited along a swift stream like the Rifle River is therefore coarser textured than that deposited along a slow, sluggish stream like Saganing Creek.

Organic material is made up of deposits of plant remains. After the glaciers withdrew from the area, water was left standing in depressions in outwash and till plains. Grasses and sedges growing around the edges of these lakes died, and their remains fell to the bottom. Because of wetness of the areas, the plant remains did not decompose but remained around the edge of the lake. Later white-cedar and other water-tolerant trees grew on the areas. As these trees died their residues became a part of the organic accumulation. The lakes were eventually filled with organic material and developed into areas of muck and peat. In some of these areas, the plant remains subsequently decomposed. In other of the areas, the material has changed little since deposition. Soils of the Carbondale series are an example of soils formed in organic material.

Some of the soils in the county formed in more than one kind of parent material. For example, the Isabella soils formed partly in sandy material and partly in glacial till.

Climate

Climate is important in the formation of soils. It determines the kind of plant and animal life on and in the soil. It determines the amount of water available for weathering of minerals and the transporting of soil materials. Climate through its influence on temperatures in the soil determines the rate of chemical reaction that occurs in the soil. These influences are important but affect large areas rather than a small area such as a county. The soils in Arenac County differ from soils formed in a dry, warm climate or from those that formed in a hot, moist climate. In Arenac County the soils formed in a cool and humid climate greatly influenced by the closeness of Lake Huron. Normally the climate is uniform throughout the county and has had little influence on the differences among the various soils. The climate of Arenac County is discussed in more detail in the section "General Nature of the County."

Plant and animal life

Plants have been the principal organism influencing the formation of soils in this county, but bacteria, fungi, earthworms, and activities of man have also been important. Two of the chief functions of plant and animal life are to furnish organic matter and to bring plant nutrients from the lower part of the solum to the upper layers. The kind of organic material on and in the soil depends on the kind of plants that grew on the soil. The remains of these plants accumulate on the surface, decay, and eventually become organic matter. Roots of the plants provide channels for downward movement of water through the soil and also add organic matter as they decay. Bacteria in the soil help to break down the organic matter so that it can be used by growing plants.

The vegetation in Arenac County was mainly forests.

The trees were of various kinds, depending on drainage of the soil.

Relief and drainage

Relief and drainage have had a marked influence on the formation of soils in Arenac County. The soils in the county range from nearly level to steep. Drainage ranges from good on the ridgetops to poor or very poor in the depressions.

Relief influences the formation of soils by controlling runoff and drainage; drainage, in turn, through its affect on aeration of the soils determines the color of the soils. Runoff is greatest on the steepest slopes, but in places in low areas, it is temporarily ponded. Water and air move freely through soils that are well drained but slowly or very slowly through soils that are poorly drained or very poorly drained. In soils that are well aerated, the iron and aluminum compounds that give most soils their color are brightly colored and oxidized, and in poorly aerated soils the colors are dull gray and reduced. Where drainage is restricted colors are mottled.

Organic soils (muck and peats) formed in marshes and swamps. These soils consist of organic material from various kinds of plants. They are very poorly drained and have a dark-colored surface layer. Their properties depend largely on the kinds of plants from which they formed, the level of the water table, and the mineral content of the water.

Poorly drained mineral soils formed in low areas where water did not cover the soil completely or continuously enough for organic soils to form. Aeration was poor and the organic matter better preserved than in well-drained soils. Beneath the dark-colored layer of organic-mineral material, the soils are gray in color.

Well-drained soils formed where natural drainage was good and where air could enter the soil. These soils generally are free of mottling and are bright colored. Moderately well drained soils are similar to the well drained soils, but they are mottled at a depth below 3 feet, which indicates infrequent saturation at this depth.

Intermediate between the poorly drained and well drained and moderately well drained soils are the somewhat poorly drained soils. These soils formed in low areas that were saturated for part of the year. They are strongly mottled. Their base colors are slightly duller than those of the well drained and moderately well drained soils.

Time, or age

Time is required by the active agents of soil formation to form soils from parent material. Some soils form rapidly, others slowly. The length of time required for a particular soil to form depends on the other factors involved.

The glacial deposits, from which many of the soils in Arenac County formed, have been exposed to soil-forming factors for a long enough time to allow distinct horizons to develop within the soil profile. On the other hand, soils forming in recent alluvial sediments have not been in place long enough for distinct horizons to develop. The characteristics of such soils are largely those of the deposited materials.

The rate at which a process of formation operates varies with the conditions that prevail during the time of formation. Lime, for example, is leached more rapidly from sand than from clay in which the downward movement of water is slower.

The Sims and Wisner soils in the southern part of the county are examples of the effect of time on leaching. Sims soils are west and above a series of beach ridges, and Wisner soils are east and below these ridges. As a result, when the level of the body of water preceding that of Lake Huron stood at the levels marked by the beaches, the Sims soils were above water and subject to leaching. In contrast the Wisner soils were submerged and protected from leaching. This difference in length of time of leaching is reflected in the Sims soils, which are leached of lime to a depth of 10 to 18 inches. The Wisner soils, on the other hand, remain calcareous at or near the surface.

Classification of Soils

The soil series of Arenac County have been placed in great soil groups. The soils in any one group have similar kinds of horizons in the same sequence in their profiles, but they may differ greatly in some characteristics, such as relief, texture, and thickness of the profile. Some of the soils have characteristics of one great soil group but also have characteristics of another group. Such soils in this county are in the Podzol great soil group. Some soils in this group have an upper sequum typical of Podzols and a lower sequum typical of Gray Wooded soils.

The classification of the soil series into great soil groups is shown in the list that follows. Then each great soil group is discussed.

Great soil group:

	Series
Podzol	Allendale, Au Gres, Belding, Bohemian, Brimley, Duel, Eastport, Gladwin, Ingalls, Iosco, Isabella, Mancelona, Manistee, Menominee, Richter, Rousseau, Rubicon, Twining, Ubly, Wainola.
Gray Wooded	Bowers, Kawkawlin, Kent, Nester, Rudyard, Selkirk.
Brown Forest	Summerville.
Brown Podzolic	Grayling.
Humic Gley	Bergland, Brevort, Bruce, Burleigh, Charity, Deford, Epoufette, Essexville, Hettinger, Lacota, Maumee, Pickford, Pinconning, Roscommon, Saganing, Sims, Tobico, Tonkey, Wisner.
Ground-Water Podzol.	Saugatuck.
Bog (organic)	Adrian, Carbondale, Dawson, Edwards, Greenwood, Linwood, Markey, Rifle, Tawas, Warners, Willette.

Podzols.—Most of the sandy, well drained and moderately well drained soils and somewhat poorly drained soils in the county are Podzols. These soils characteristically have a very thin, dark-colored, mineral A1 layer, which is underlain by an eluviated, leached A2 layer that is ash gray in color. The Bh or Bhir horizon contains an accumulation of brown iron oxides and humus that has been leached out of the overlying horizons. Typical Podzols in this county are those of the Allendale, Au Gres, Duel, Eastport, Ingalls, Rousseau, Rubicon, and Wainola series.

Some soils in the Podzol group have a Podzol upper sequum and a Gray Wooded lower sequum. In general a Podzol sequence of A1, A2, Bh or Bir horizons is underlain by a Gray Wooded sequence of A'2 and A'2 & B'21 or B't horizons. In some soils the Podzol A2 horizon is thin and, under cultivation, is incorporated in the Ap horizon. The A'2 horizon is grayish brown, but it is very thin or lacking in some soils. In the A'2 & B'21 horizon, or B'21 & A'2 horizon, the A'2 material occurs in cracks and along structure planes and as thick coatings on the surfaces of peds. In the upper part of the B'2 horizon, small chunks of B'2 material are partly or wholly surrounded by A'2 material. The B'22 or B't horizon is enriched by clay that washed down from the overlying horizons, or by clay that developed in place, or by both. In soils developed in loamy sand, the B't horizon occurs as thin, commonly discontinuous layers that are separated by layers of the A'2 horizon. The Belding, Bohemian, Brimley, Gladwin, Iosco, Isabella, Mancelona, Manistee, Menominee, Richter, Twining, and Ubly soils are the soils in the county that have a Podzol upper sequum and a Gray Wooded lower sequum.

Gray Wooded soils.—Gray Wooded soils formed in moderately fine textured materials in areas where Podzols are dominant on coarser textured materials. These soils have a thin, dark-colored A1 horizon, a B2 & A2 horizon in which the A2 part occurs as thick coatings around peds and along cleavage planes; a B2 horizon that has an accumulation of clay; and a C horizon. Gray Wooded soils are similar to Gray-Brown Podzolic soils in some respects, but their A2 horizon is grayer than the A2 horizon of the Gray-Brown Podzolic soils in southern Michigan, Indiana, and western Ohio, and the upper part of the B horizon in Gray Wooded soils occurs as peds that are partly or wholly surrounded by A2 material.

Gray Wooded soils are somewhat poorly drained. The C horizon in most of the soils is limy. Soils of the Bowers, Kawkawlin, Kent, Nester, Rudyard, and Selkirk series are in the Gray Wooded soil group in this county.

Brown Forest soils.—Brown Forest soils formed under forest in calcareous, stratified silt and fine sand. These soils have a fairly thick, dark-colored A1 horizon; a neutral to alkaline B horizon that has been leached of carbonates but has gained little or no clay; and a calcareous C horizon. They lack the eluviated A2 horizon that is characteristic of Podzols and Gray Wooded soils. In this county the Summerville series are the only Brown Forest soils, and they are inextensive. These soils have a sequence of A1, A2, and B horizons underlain by limestone bedrock at a depth of less than 18 inches.

Brown Podzolic soils.—These soils formed in sand. They have a fairly thin, dark-colored A1 horizon, a yellowish-brown B horizon, and a very pale brown C horizon. The A2 horizon is only 1 or 2 inches thick or is lacking. Only small amounts of iron oxide and humus have accumulated in the B horizon. This accumulation is considerably smaller than that in the B horizon of Podzols, either because the A horizon lacks enough iron to permit leaching and subsequent accumulation in the B horizon or because the organic acids are of a kind not favorable for this leaching and accumulation. Soils of the Grayling series are the only soils classified as Brown Podzolic soils in this county.

Humic Gley soils.—Humic Gley soils are poorly or very poorly drained and formed in nearly level or depressional areas. They have a thick, black to very dark gray or very dark brown A1 horizon that is high in content of organic matter. This is underlain by a gray to grayish-brown B or Bg horizon that, in some places, is mottled with yellowish brown or darker brown and overlies a C horizon. The gray colors in the B or Bg horizon are the result of poor drainage and poor aeration and the reduction of iron in the presence of organic matter. In some places these soils are covered by as much as 12 inches of peat or muck. Soils of the Bergland, Brevort, Bruce, Burleigh, Charity, Deford, Epoufette, Essexville, Hettinger, Lacota, Maumee, Pickford, Pinconning, Roscommon, Saganing, Sims, Tobico, Tonkey, and Wisner are Humic Gley soils in this county.

Ground-Water Podzols.—Ground-Water Podzols have formed in deep, very sandy material where the water table generally is within 2 to 4 feet of the surface. These soils resemble Podzols in many respects, but they differ in that the A2 horizon is thicker and nearly white in color, and the upper B horizon is thicker and very strongly cemented in a form called ortstein. Ground-Water Podzols are of limited extent in this county and are represented by only the Saugatuck series.

Bog (organic) soils.—The Bog, or organic soils, consist of organic materials more than 12 inches thick. These soils are in old marshes and lakebeds. They range from well-decomposed muck to raw peat and are very poorly drained. In places they are more than 40 feet deep. The organic materials accumulated in water and have been preserved because the water retarded their decomposition or oxidation. The degree of decomposition is controlled largely by the kind of original plant material and the height of the water table. Organic soils that developed from woody plants, sedges, and reeds are normally more decomposed than those that developed from sphagnum moss. Organic soils in this county are members of the Adrian, Carbondale, Dawson, Edwards, Greenwood, Lindwood, Markey, Rifle, Tawas, Warners, and Willette series.

Detailed Descriptions of Soil Series [9]

In this section the soil series in Arenac County are described in alphabetic order. A representative profile is described in detail for each series.

The color of the soil is indicated in two ways in this section. It is first indicated by a descriptive term, for example, grayish brown. Then it is indicated by a Mun-

[9] By LLOYD MCKINZIE, Michigan State University, Soils Department.

sell notation, such as (10YR 5/2). The Munsell notation denotes color more precisely than is possible by the use of words. Unless otherwise stated, the color given is for moist material.

Less technical descriptions of each series are given in the section "Descriptions of the Soils." These descriptions contain some interpretive and other information not given in the detailed descriptions of the soil series.

ADRIAN SERIES

The Adrian series consists of Bog soils formed in moderately decomposed peat and muck derived mainly from reeds and sedges. These soils are underlain by sand to loamy sand at a depth of 12 to 42 inches. The original vegetation was sedges, grasses, reeds, willow, and tag alder.

Adrian soils are less decomposed and more acid than the Tawas soils but are less acid and more decomposed than the Dawson soils. They formed in shallower deposits of organic material than the Rifle soils, in which the organic material is more than 42 inches thick.

Profile of Adrian muck on Point Au Gres (SW¼ sec. 6, T. 18 N., R. 7 E.):

1—0 to 12 inches, black (10YR 2/1) muck that contains woody material; fine, granular structure; friable; slightly acid; gradual, smooth boundary.
2—12 to 20 inches, dark yellowish-brown (10YR 4/4) peat; fibrous; friable; slightly acid; gradual, smooth boundary.
3—20 to 26 inches, very dark grayish-brown (10YR 3/2) peat; fibrous; strongly acid; abrupt, wavy boundary.
IIC—26 to 42 inches +, light brownish-gray (2.5Y 6/2) sand; single grain; loose; medium acid.

The second layer is muck in some areas. Reaction of the organic layers ranges from strongly acid to neutral. The IIC horizon ranges from sand to loamy sand and is at a depth of 12 to 42 inches. Finer textured material is at a depth below 42 inches in a few places.

ALLENDALE SERIES

The Allendale series consists of somewhat poorly drained Podzols. These soils formed in sand or loamy sand 18 to 42 inches thick and are underlain by silty clay or clay. The original vegetation was forests of upland and lowland hardwoods that contained a few white pines.

Allendale soils are somewhat poorly drained. They are in the same catena as the well drained and moderately well drained Manistee soils and the poorly drained and very poorly drained Pinconning soils. The solum is similar to the solum of Iosco soils, but unlike those soils, Allendale soils are underlain by silty clay to clay. The Allendale soils formed in shallower sandy deposits than the loamy substratum phases of the Au Gres series, which are underlain by loam to clay at a depth of 42 to 66 inches.

Profile of Allendale loamy sand (SE¼NE¼ sec. 17, T. 20 N., R. 6 E.:

A1—0 to 3 inches, black (10YR 2/1) loamy sand; very weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.
A2—3 to 10 inches, light brownish-gray (10YR 6/2) sand; very weak, medium, granular structure; very friable; neutral; abrupt, wavy boundary.
B21ir—10 to 20 inches, yellowish-brown (10YR 5/6) sand; common, coarse mottles of faint brown (7.5YR 5/4); very weak, medium, subangular blocky structure; very friable; mildly alkaline; gradual, smooth boundary.
B22ir—20 to 23 inches, yellowish-brown (10YR 5/8) sand; single grain; loose; mildly alkaline; abrupt, smooth boundary.
IIB't—23 to 25 inches, reddish-brown (5YR 5/4) sandy loam; weak, medium, subangular blocky structure; friable; mildly alkaline; abrupt, smooth boundary.
IIIC—25 to 45 inches +, reddish-brown (5YR 5/4) clay; common, medium, distinct mottles of strong brown (7.5YR 5/6) and a few, medium, prominent mottles of gray (5YR 6/1); weak, coarse, angular blocky structure; firm; calcareous.

In cultivated fields plowing has mixed material from the upper part of the A2 horizon with the A1 horizon to form a dark-gray plow layer. In areas where the depth of plowing is 10 inches or more, the A2 horizon is very thin or is absent. The color of the B21ir horizon ranges to dark brown (7.5YR 4/4) or dark reddish brown (5YR 3/2) in places. Chunks of firmly cemented ortstein are in the B21ir horizon in many places. The IIB't horizon is absent in places, and here the sand rests directly on clay. A IIIB't horizon is in the upper 2 to 6 inches of the clay in some areas.

AU GRES SERIES

The Au Gres series consists of somewhat poorly drained Podzols. These soils formed in sand on nearly level and gently sloping outwash plains. The original vegetation was stands of cedar, fir, hemlock, and aspen that included a few northern hardwoods.

Au Gres soils are similar to the Saugatuck soils but lack the cemented ortstein horizon of those soils. Unlike the Wainola soils, which formed in fine sand and loamy fine sand, Au Gres soils formed in medium sand and coarse sand.

Profile of Au Gres sand[10] (NE¼SE¼ sec. 27, T. 20 N., R. 3 E.):

A1—0 to 4 inches, dark-gray (10YR 4/1) sand; very weak, medium, granular structure; very friable; very strongly acid; abrupt, wavy boundary.
A2—4 to 9 inches, light brownish-gray (10YR 6/2) sand; single grain; loose; strongly acid; abrupt, wavy boundary.
B21hir—9 to 12 inches, dark reddish-brown (5YR 3/3) sand; weak, coarse, granular structure; very friable; strongly acid; gradual, irregular boundary.
B22hir—12 to 17 inches, dark yellowish-brown (10YR 4/4) sand; weak, coarse, granular structure; very friable; medium acid; gradual, wavy boundary.
B3—17 to 30 inches, light yellowish-brown (10YR 6/4) sand; common, medium, distinct mottles of strong brown (7.5YR 5/6) and very pale brown (10YR 7/3); single grain; loose; medium acid; gradual, wavy boundary.
C—30 to 60 inches +, light-gray (10YR 7/2) sand; many, coarse, prominent mottles of yellowish brown (10YR 5/8); single grain; loose; slightly acid.

In cultivated areas plowing has mixed the upper part of the A2 horizon with the A1 horizon to form a gray plow layer. In some areas a 2-inch to 4-inch A0 horizon, consisting of undecomposed twigs and leaves is on the surface. The color of the B21hir horizon ranges from dark reddish brown (5YR 3/3 to 5/2) to dark brown (7.5YR 4/4 or 4/2). Chunks of cemented ortstein are in this horizon in places. The texture of the B21hir is

[10] Shown as Arenac in material published by the University of Michigan Agricultural Experiment Station if loam to clay is at a depth of 42 to 66 inches.

loamy sand in some areas. The lower part of the C horizon is calcareous in a few areas. Depth to mottling ranges from 6 to about 18 inches. The solum is slightly acid to very strongly acid. Below a depth of 42 inches the material ranges from loam to clay in some areas. The water table is within 3 feet of the surface in many places.

BELDING SERIES

The Belding series consists of soils that have an upper sequum typical of Podzols and a lower sequum typical of Gray Wooded soils. These soils are on nearly level to gently sloping ground moraines throughout the county. They formed in loamy fine sand to fine sandy loam and are underlain by loam to silty clay loam at a depth of 18 to 42 inches. The native vegetation was mainly upland and lowland hardwoods but included a few white pines.

These soils are somewhat poorly drained. They are in the same catena as the well drained and moderately well drained Ubly soils. They are closely associated with the Twining soils but formed in deeper deposits of loamy fine sand to fine sandy loam. Their upper solum is finer textured than that of the Iosco soils.

Profile of Belding loamy fine sand:

Ap—0 to 8 inches, very dark gray (10YR 3/1) loamy fine sand; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

Bir—8 to 18 inches, dark-brown (7.5YR 4/4) loamy fine sand; weak, fine, granular structure; very friable; slightly acid; clear, wavy boundary.

A'2—18 to 20 inches, pale-brown (10YR 6/3) sandy loam; common, medium, distinct mottles of yellowish brown (10YR 5/6); weak, medium, platy structure; friable; slightly acid; abrupt, irregular boundary.

IIB'21t—20 to 22 inches, brown (7.5YR 4/4) clay loam that contains material from the A2 horizon in cracks; moderate, fine, angular blocky structure; firm; neutral; diffuse, irregular boundary.

IIB'22t—22 to 36 inches, brown (7.5YR 5/4) clay loam; common, fine, faint mottles of dark brown (7.5YR 4/4) and common, medium, distinct mottles of light brownish gray (10YR 6/2); firm; neutral; abrupt, wavy boundary.

IIC—36 to 42 inches +, light-brown (7.5YR 6/4) clay loam; many, medium, distinct mottles of yellowish brown (10YR 5/8) and light brownish gray (10YR 6/2); weak, medium, angular blocky structure; firm; calcareous.

In undisturbed areas an A2 horizon that is pinkish gray (7.5YR 6/2) or light brownish gray (10YR 6/2) and 2 to 6 inches thick occurs above the Bir horizon. The Podzol sequum ranges from loamy fine sand to sandy loam in texture. It ranges from 18 to 42 inches in thickness but is dominantly 20 to 30 inches thick. Texture of the IIB't horizon is dominantly clay loam, but it ranges to heavy loam or silty clay loam. In places the IIC horizon is loam or silty clay loam. Depth to free carbonates ranges from 24 to 40 inches. The Podzol sequum ranges from medium acid to slightly acid, and the Gray Wooded sequum from slightly acid to mildly alkaline.

BERGLAND SERIES

The Bergland soils are in the Humic Gley great soil group. These soils are in level to depressional areas. They formed in lacustrine deposits or in clay or silty clay from glacial till. The native vegetation was a swamp forest of hemlock, cedar, ash, elm, and soft maple.

These soils are very poorly drained. They are in the same catena as the well drained and moderately well drained Kent soils, the somewhat poorly drained Selkirk soils, and the poorly drained Pickford soils. All of these soils formed in clay or silty clay from glacial till. The Bergland soils are also in the catena that includes the somewhat poorly drained Rudyard soils and the poorly drained Pickford soils, which formed in lacustrine clay or silty clay. They are finer textured than the Sims and Hettinger soils, which formed in silty clay loam or clay loam. They are similar to the Charity soils, but those soils are calcareous at or near the surface. Bergland soils lack the organic upper horizons typical of the Willette soils.

Profile of Bergland mucky loam:

A11—0 to 6 inches, black (N 2/0) mucky loam; coarse, medium, granular structure; friable; neutral; clear, wavy boundary.

A12—6 to 15 inches, black (10YR 2/1) heavy silty clay loam; moderate, fine, subangular blocky structure; firm; neutral; clear, wavy boundary.

Bg—15 to 24 inches, light brownish-gray (2.5Y 6/2) clay; weak, coarse, angular blocky structure; very firm; mildly alkaline; abrupt, wavy boundary.

C—24 to 42 inches +, light brownish-gray (2.5Y 6/2) clay; a few, coarse, distinct mottles of light olive brown (2.5Y 5/4); massive; very firm; calcareous.

Some undisturbed areas have a layer of muck 2 to 12 inches thick on the surface. Texture of the surface soil in most areas is mucky loam. Depth to the underlying clay ranges from 8 to 14 inches. The texture of the Bg and C horizons is silty clay. In a few places the C horizon contains strata of silt. Depth to the calcareous C horizon ranges from 16 to 36 inches. The solum ranges from slightly acid to mildly alkaline.

BOHEMIAN SERIES

Soils of the Bohemian series have an upper sequum typical of Podzols and a lower sequum typical of Gray Wooded soils. These soils formed in stratified silt and very fine sand that in a few places included strata of material of other textures. They are nearly level to rolling. The original vegetation was stands of northern hardwoods and white pines.

These soils are well drained and moderately well drained. They are in the same catena as the somewhat poorly drained Brimley soils and the poorly drained and very poorly drained Bruce soils. They have a coarser textured solum than the Nester soils and a coarser textured B't horizon than the Ubly soils.

Profile of Bohemian very fine sandy loam (SW¼SE¼ of NW¼, sec. 21, T. 20 N., R. 5 E.):

A1—0 to 3 inches, very dark gray (10YR 3/1) very fine sandy loam; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

A2—3 to 4 inches, light brownish-gray (10YR 6/2) fine sandy loam; very weak, medium, granular structure; very friable; neutral; clear, wavy boundary.

Bir—4 to 12 inches, brown (7.5YR 4/4) fine sandy loam; weak, fine, subangular blocky structure; friable; neutral; clear, wavy boundary.

A2—12 to 17 inches, pale-brown (10YR 6/3) fine sandy loam; weak, thick, platy structure; friable; neutral; clear, wavy boundary.

B'21t—17 to 19 inches, brown (7.5YR 5/4) light sandy clay loam, with pinkish gray (7.5YR 6/2) coatings; moderate, medium, subangular blocky structure; firm

when moist, slightly plastic when wet; neutral; clear, wavy boundary.

IIB'22t—19 to 28 inches, brown (7.5YR 5/4) silty clay loam; moderate, medium, subangular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.

IIC1—28 to 48 inches, brown (7.5YR 5/2) silt and very fine sand; a few, medium, distinct mottles of light brownish gray (10YR 6/2); weak, thick, platy structure; firm; calcareous; clear, wavy boundary.

IIC2—48 to 63 inches +, brown (10YR 5/3) silt; a few, fine, faint mottles of yellowish brown (10YR 5/6); weak, thick, platy structure; friable; calcareous.

The A1 and A2 horizons and part of the Bir horizon generally make up the Ap horizon in cultivated areas. In some cultivated areas an A2 horizon 1 to 3 inches thick is below the Ap horizon. The Bir horizon ranges to dark yellowish brown (10YR 4/4). The texture of the Podzol sequum is silt, silt loam, or stratified very fine sandy loam and silt. The A2 horizon ranges to grayish brown (10YR 5/2) in color and from 2 to 7 inches in thickness. The B't horizon ranges to dark yellowish brown (10YR 4/4) in color. Its texture ranges from light sandy clay loam to heavy silt loam or light silty clay loam. The IIC horizon ranges from silt or silt loam to very fine sand or consists of thin strata of silt and very fine sand. Depth to the C horizon ranges from 20 to 36 inches.

BOWERS SERIES

In the Bowers series are Gray Wooded soils on nearly level lake plains. These soils formed in stratified, calcareous silty clay loam and clay loam that contained strata or lenses of silt, silt loam, clay, and sandy loam.

These soils are somewhat poorly drained. They are in the same catena as the poorly drained and very poorly drained Hettinger soils. Bowers soils formed in finer textured material than the Brimley and Rudyard soils. Their texture is more variable than that of the Kawkawlin soils, which formed in clay loam or silty clay loam till.

Profile of Bowers loam (NE¼NW¼ sec. 14, T. 20 N., R. 3 E.):

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2g—7 to 13 inches, light brownish-gray (10YR 6/2) silt loam; a few, fine, distinct mottles of dark yellowish brown (10YR 4/4); weak, fine, granular structure; friable; slightly acid; clear, wavy boundary.

Bt—13 to 30 inches, brown (7.5YR 5/4) silty clay loam that contains thin lenses of clay loam, silt loam, and sandy loam; common, medium, faint mottles of dark brown (7.5YR 4/4) and common, medium, distinct mottles of pinkish gray (7.5YR 7/2); weak, medium, angular blocky structure; clay coatings on numerous cleavage faces; firm when moist, slightly plastic when wet; slightly acid; abrupt, wavy boundary.

C—30 to 42 inches +, pale-brown (10YR 6/3) stratified clay loam and silty clay loam that contain thin strata of silt loam, clay, and sandy loam; many, medium, distinct mottles of grayish brown (10YR 5/2) and yellowish brown (10YR 5/6); weak to coarse, subangular blocky structure; firm when moist; slightly plastic when wet; calcareous.

Undisturbed areas have a very dark gray (10YR 3/1) A1 horizon that is 1 to 3 inches thick. The thickness and sequence of stratification vary within a short distance. The stratified layers consist mainly of silty clay loam and clay loam but include lenses of silt, silt loam, sandy loam, clay, and very fine sand. They range from ½ inch to 4 inches in thickness, and not all of these textures occur at any one location. Depth to calcareous material ranges from 22 to about 42 inches.

BREVORT SERIES

Soils of the Brevort series are in the Humic Gley great soil group. They are on broad low till and lake plains, along minor drainageways, and in depressions in moraines. These soils formed under lowland hardwoods in sand to loamy sand 18 to 42 inches thick. They are underlain by loam to silty clay loam.

These soils are poorly drained and very poorly drained. They are in the same catena as the well drained and moderately well drained Menominee soils and the somewhat poorly drained Iosco soils. They are similar to the Essexville soils, but those soils are calcareous at or within 10 inches of the surface. They are also similar to the Pinconning soils, but those soils are underlain by clay or silty clay.

Profile of Brevort fine sandy loam (NW¼SW¼ sec. 8, T. 19 N., R. 4 E.):

A1—0 to 5 inches, black (10YR 2/1) fine sandy loam; weak, fine, granular structure; friable; slightly acid; clear, wavy boundary.

B1—5 to 10 inches, dark grayish-brown (10YR 4/2) loamy sand; very weak, medium, subangular blocky structure; very friable; neutral; clear, wavy boundary.

B2—10 to 18 inches, grayish-brown (10YR 5/2) sand; very weak, medium, subangular blocky structure; very friable; neutral; clear, wavy boundary.

B3g—18 to 24 inches, gray (10YR 5/1) sand; single grain; loose; neutral; abrupt, wavy boundary.

IIC—24 to 42 inches +, brown (7.5YR 5/4) clay loam; many, fine, distinct mottles of strong brown (7.5YR 5/6) and gray (7.5YR 6/1); moderate, fine, subangular blocky structure; firm; calcareous.

A layer of muck 1 to 12 inches thick is on the surface in some wooded areas. The texture of the surface soil is fine sandy loam, loamy sand, or sand. Depth to the IIC horizon ranges from 18 to 42 inches. In areas where the depth is nearly 42 inches, a Cg horizon of calcareous, loose, gray sand that is sometimes mottled is above the IIC horizon. The sandy part of the profile ranges from slightly acid to neutral. The texture of the IIC horizon ranges from clay loam to sandy clay loam or silty clay loam.

BRIMLEY SERIES

Soils of the Brimley series have an upper sequum typical of Podzols and a lower sequum typical of Gray Wooded soils. They formed in stratified silt and very fine sand. The areas are nearly level to gently undulating. Stands of northern hardwoods that included a few conifers made up the original vegetation.

These soils are somewhat poorly drained. They are in the same catena as the well drained and moderately well drained Bohemian soils and the poorly drained and very poorly drained Bruce soils. Brimley soils formed in coarser textured material than the Bowers soils and in finer textured material than the Richter soils. They are similar to the Ingalls soils, but those soils formed in sand or loamy sand over silt and very fine sand.

Profile of Brimley fine sandy loam (NE¼NW¼ sec. 27, T. 20 N., R. 5 E.):

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; moderate, coarse, granular structure; friable; slightly acid; abrupt, smooth boundary.
A2—7 to 10 inches, pale-brown (10YR 6/3) loamy very fine sand; moderate, medium, platy structure; very friable; neutral; clear, wavy boundary.
Bir—10 to 14 inches, brown (7.5YR 4/4) loam; moderate, fine, subangular blocky structure; friable; mildly alkaline; abrupt, wavy boundary.
A'2—14 to 15 inches, brown (10YR 5/3) silt loam; moderate, fine, subangular blocky structure; friable; mildly alkaline; abrupt, irregular boundary.
B't—15 to 25 inches, brown (7.5YR 5/4) light silty clay loam; common, medium, distinct mottles of strong brown (7.5YR 5/8); moderate, fine, subangular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.
C—25 to 42 inches +, brown (10YR 5/3) stratified silt and very fine sand; common, medium, distinct mottles of brownish yellow (10YR 6/8) and light yellowish-brown (10YR 6/4); moderate, thin, platy structure; friable; calcareous.

The surface layer is loamy fine sand, fine sandy loam, or loam. In undisturbed areas the A1 horizon is very dark gray (10YR 3/1) and is 1 to 4 inches thick. The A2 horizon is absent in some cultivated areas. The B't horizon ranges from light silty clay loam to silt loam, clay loam, or heavy fine sandy loam. The C horizon is dominantly very fine sand and silt, but it includes some strata or discontinuous layers of loamy fine sand, fine sandy loam, very fine sandy loam, silt loam, loam, or silty clay loam. Depth to calcareous material ranges from 18 to 36 inches. The solum ranges from slightly acid to mildly alkaline.

BRUCE SERIES

The Bruce series consists of Humic Gley soils on nearly level lake plains and along drainageways. These soils formed in stratified, lacustrine very fine sand and silt. Stands of swamp hardwoods made up the original vegetation.

The poorly drained and very poorly drained Bruce soils are in the same catena as the well drained and moderately well drained Bohemian soils and the somewhat poorly drained Brimley. The Bruce soils are coarser textured than the Hettinger soils and finer textured than the Tonkey. They are similar to the Burleigh soils, but those soils formed in deposits of sand or loamy sand.

Profile of Bruce silt loam (NW¼NW¼ sec. 20, T. 20 N., R. 7 E.):

A11—0 to 5 inches, black (10YR 2/1) silt loam; moderate, fine, granular structure; friable; mildly alkaline; abrupt, smooth boundary.
A12—5 to 11 inches, very dark gray (10YR 3/1) loam; weak, medium, subangular blocky structure; friable; mildly alkaline; abrupt, wavy boundary.
B21g—11 to 18 inches, dark-gray (10YR 4/1) clay loam; a few, medium, distinct mottles of yellowish brown (10YR 5/6); moderate, medium, angular blocky structure; firm; mildly alkaline; abrupt, smooth boundary.
B22g—18 to 22 inches, grayish-brown (2.5Y 5/2) loam; mottles of yellowish brown (10YR 5/6); coarse, subangular blocky structure; friable; mildly alkaline; abrupt, wavy boundary.
IIC1—22 to 28 inches, pale-brown (10YR 6/3) loamy fine sand; single grain; loose; calcareous; abrupt, smooth boundary.
IIIC2—28 to 44 inches, dark grayish-brown (10YR 4/2) stratified very fine sand and silt with thin lenses of pale-brown (10YR 6/3) silt loam; weak, medium, platy structure; friable; calcareous.

A layer of muck 2 to 6 inches thick is on the surface in some areas. The surface layer is loamy fine sand, fine sandy loam, or silt loam. The thickness and sequence of the strata comprising the B and C horizons vary within a short distance. The thickness of the IIIC2 horizon, which consists of strata of very fine sand and silt, ranges from 3 to more than 16 inches. This layer contains layers of clay loam, silty clay loam, sandy loam, or sand 1 to 2 inches thick in most places. The solum ranges from slightly acid to mildly alkaline. Depth to the calcareous C horizon ranges from 15 to 30 inches.

BURLEIGH SERIES

The Burleigh series consists of Humic Gley soils in nearly level areas. These soils formed in sand or loamy sand, 18 to 42 inches thick, underlain by stratified very fine sand and silt. Stands of swamp hardwoods, marsh grasses, and sedges made up the original vegetation.

The Burleigh soils are poorly drained and very poorly drained. They are in the same catena as the somewhat poorly drained Ingalls soils. They are similar to the Pinconning and Brevort soils, but those soils are underlain by finer textured material.

Profile of Burleigh loamy sand (NW¼SW¼ sec. 28. T. 19 N., R. 6 E.):

A11—0 to 8 inches, black (10YR 2/1) loamy sand; weak, fine, granular structure; very friable; high in organic matter; slightly acid; gradual, smooth boundary.
A12—8 to 12 inches, very dark grayish-brown (10YR 3/2) loamy sand; many, medium, faint mottles of dark grayish brown (10YR 4/2); weak, medium, subangular blocky structure; very friable; slightly acid; clear, wavy boundary.
B—12 to 18 inches, light yellowish-brown (10YR 6/4) sand; many, medium, distinct mottles of pale yellow (2.5Y 8/4); weak, thick, platy structure; very friable; slightly acid; gradual, wavy boundary.
C1g—18 to 25 inches, very pale brown (10YR 7/4) sand; single grain; loose; neutral; abrupt, wavy boundary.
IIC2g—25 to 42 inches +, light brownish-gray (2.5Y 6/2) stratified very fine sand and silt; many, medium, distinct mottles of pale brown (10YR 6/3) and reddish yellow (7.5YR 6/6); weak, medium, platy structure; very friable; calcareous.

Cultivated areas have a black (10YR 2/1) Ap horizon 6 to 10 inches thick. Some undisturbed areas have 2 to 7 inches of muck on the surface. The texture of the upper part of the solum ranges from sand to loamy sand. The texture of the IIC horizon is dominantly very fine sand and silt, but lenses of fine sand, fine sandy loam, silt loam, and silty clay loam occur in some areas. Depth to the IIC horizon ranges from 18 to 42 inches. The IIC horizon is generally calcareous, but the upper few inches are leached in some areas.

CARBONDALE SERIES

The Carbondale series consists of Bog soils derived from layers of plant material more than 42 inches thick. The soils are on low-lying lake and outwash plains that are mostly covered with trees. Stands of lowland hardwoods that included some cedar, spruce, and tamarack made up the original vegetation.

These soils are less acid and more decomposed than the Rifle soils. The deposits in which they formed are thicker than those in which the Tawas, Linwood, and Willette soils formed. Carbondale soils are thicker over underlying material than the Edwards and Warners soils, which have an underlying layer of marl.

Profile of Carbondale muck (NW¼SW¼ sec. 22, T. 20 N., R. 7 E.):

1—1½ inches to 0 of undecomposed and partly decomposed leaves and twigs; consists of leaf fall more than 1 year old.
2—0 to 4 inches, black (5YR 2/1) muck; moderate, fine, granular structure; very friable; strongly acid; clear, wavy boundary.
3—4 to 14 inches, dark reddish-brown (5YR 2/2) muck; fibrous; very friable; medium acid; clear, wavy boundary.
4—14 to 30 inches, black (10YR 2/1) muck; moderate, thin, platy structure; friable; slightly acid; gradual, wavy boundary.
5—30 to 60 inches +, black (10YR 2/1) muck; weak, medium, subangular blocky structure; friable; slightly acid.

The layer of leaves and twigs is absent in cleared areas and in some wooded areas as well. This layer consists dominantly of woody material but also includes thin layers of herbaceous material. In some areas horizons 4 and 5 consist of peat. Mineral material is at a depth of 42 inches in some areas. These soils range from strongly acid to neutral to a depth of 42 inches, but the dominant range is medium acid to slightly acid.

CHARITY SERIES

Soils of the Charity series are in the Humic Gley great soil group. These soils formed in deposits of clay to silty clay of till or lacustrine origin. They are mainly below the lowest beach ridge on lake plains, but some areas are along the Au Gres River, north of Au Gres. The original vegetation was stands of swamp hardwoods that included a few conifers.

These soils are similar to the Pickford and Bergland soils, but unlike those soils are calcareous at or near the surface. They are finer textured and calcareous at a shallower depth than the Sims or Hettinger soils, and they are more poorly drained than the Rudyard or Selkirk soils. Charity soils are finer textured than the Wisner soils, which are also calcareous.

Profile of Charity silty clay loam (SE¼NE¼ sec. 1, T. 19 N., R. 6 E.):

Ap—0 to 6 inches, very dark gray (10YR 3/1) silty clay loam; strong, fine, granular structure; friable; calcareous; abrupt, smooth boundary.
B21g—6 to 11 inches, grayish-brown (2.5Y 5/2) silty clay; weak, fine, angular blocky structure; very firm when moist and slightly hard when dry; calcareous; gradual, wavy boundary.
B22g—11 to 20 inches, light brownish-gray (2.5Y 6/2) silty clay; a few, fine, faint mottles of pale brown (10YR 6/3); moderate, fine, angular blocky structure; very firm when moist and hard when dry; calcareous; gradual, irregular boundary.
C—20 to 42 inches +, light brownish-gray (2.5Y 6/2) clay; massive; very firm when moist, sticky when wet; calcareous.

The surface layer is generally silty clay loam in texture, but in some uncleared areas it is mucky. The soils are generally calcareous at the surface, but in some areas the upper 1 to 10 inches is mildly alkaline. The B and C horizons are dominantly clay or silty clay in texture, but thin strata of silty clay loam and silt loam occur in some areas. Mottling is absent in some of the more poorly drained areas.

DAWSON SERIES

The Dawson series consists of extremely acid peats that are in the Bog great soil group. These soils formed from the remains of sphagnum moss, reeds, sedges, leatherleaf, and other plants. They are underlain by sand or loamy sand at a depth of 12 to 42 inches. The areas are in closed depressions, or basins. The original vegetation was mainly sphagnum moss and leatherleaf but included some tamarack and black spruce.

Dawson soils formed in thinner deposits of organic material than the Greenwood soils. They are more acid and less decomposed than the Adrian and Rifle soils.

Profile of Dawson peat (NW¼SE¼ sec. 7, T. 20 N., R. 4 E.):

1—0 to 4 inches, dark grayish-brown (10YR 4/2) sphagnum moss peat; fibrous; extremely acid; clear, wavy boundary.
2—4 to 20 inches, dark reddish-brown (5YR 3/4) peat; massive; nonsticky; extremely acid; abrupt, wavy boundary.
IICg—20 to 42 inches +, gray (10YR 5/1) sand; single grain; loose; strongly acid.

The color of the first horizon ranges to brown (10YR 5/3). The IICg horizon is loamy sand or sand but includes thin layers of finer textured material. At a depth below 42 inches, the mineral material is loam or clay loam in a few areas. The profile ranges from strongly acid to extremely acid.

DEFORD SERIES

In the Deford series are Humic Gley soils formed in waterlaid fine sand, very fine sand, and loamy sand. These soils are on broad, nearly level outwash plains and along small natural drainageways. Swamp hardwoods and black spruce made up the original vegetation.

These soils are poorly drained and very poorly drained. They are in the same catena as the well-drained Rousseau soils and the somewhat poorly drained Wainola. They are coarser textured than the Tonkey soils and formed in somewhat finer sand than the Roscommon soils, which formed in medium and coarse sand. Deford soils lack the textural Bt horizon that is characteristic of the Epoufette soils.

Profile of Deford loamy fine sand (NW¼NW¼ sec. 26, T. 20 N., R. 6 E.):

O1—4 inches to 0, dark grayish-brown (10YR 4/2) peaty muck; massive; friable; slightly acid; abrupt, smooth boundary.
A1—0 to 5 inches, very dark gray (10YR 3/1) loamy fine sand; single grain; loose; neutral; clear, wavy boundary.
Bg—5 to 14 inches, light-gray (2.5Y 7/2) fine sand; a few, fine, distinct mottles of yellow (2.5Y 7/6); weak, thin, platy structure; loose; neutral; clear, wavy boundary.
C1—14 to 27 inches, light-gray (2.5Y 7/2), stratified fine and very fine sand; single grain; loose; neutral; abrupt, wavy boundary.
C2—27 to 42 inches +, light-gray (2.5Y 7/2), stratified fine and very fine sand; single grain; loose; calcareous.

The thickness of the O1 horizon ranges from 1 to 12 inches. The A1 horizon is loam, loamy fine sand, or

loamy sand. It ranges to black (10YR 2/1) in color and from 4 to 7 inches in thickness. Thin strata of medium and coarse sand are in the profile in some areas. The material below a depth of 48 inches is loam, clay loam, or clay. Mottling is most evident in areas where drainage is poor. The profile ranges from medium acid to mildly alkaline at the surface and from neutral to calcareous in the substratum.

DUEL SERIES

In the Duel series are well drained to moderately well drained Podzols in nearly level to rolling areas. These soils formed in sand or loamy sand 18 to 42 inches thick over limestone bedrock. The original vegetation was stands of sugar maple, beech, and white pine.

These soils formed in shallower sandy deposits than the Rubicon and Rousseau soils. Unlike the Menominee and Manistee soils, Duel soils are underlain by bedrock rather than by moderately fine textured and fine textured mineral material. Duel soils are deeper over bedrock than the Summerville soils, which are underlain by limestone bedrock at a depth of less than 18 inches.

Profile of Duel loamy sand (SW¼SW¼ sec. 35, T. 20 N., R. 5 E.):

A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, medium, granular structure; very friable; mildly alkaline; abrupt, wavy boundary.
A2—3 to 7 inches, pinkish-gray (7.5YR 6/2) loamy sand; very weak, fine, granular structure; very friable; slightly acid; abrupt, wavy boundary.
B21hir—7 to 11 inches, strong-brown (7.5YR 4/4) loamy sand; weak, medium, granular structure; very friable; slightly acid; gradual, wavy boundary.
B22ir—11 to 18 inches, brown (7.5YR 5/4) sand; very weak, medium, granular structure; very friable; medium acid; abrupt, wavy boundary.
B23t—18 to 21 inches, brown to dark-brown (7.5YR 4/4) fine sand; weak, medium, granular structure; very friable; mildly alkaline; abrupt, irregular boundary.
IIR—21 inches +, light-gray (10YR 6/1) limestone bedrock; hard; calcareous.

The A1 horizon ranges to black (70YR 2/1) in color and from 1 to 4 inches in thickness. The color of the Bhir horizon ranges to dark brown (7.5YR 3/2), and that of the Bir horizon ranges to yellowish brown (10YR 5/4). Where the depth of sandy material approaches 42 inches, a B3 horizon of brown (10YR 5/3) sand or fine sand is above the bedrock. The underlying limestone is hard and shows little evidence of weathering.

EASTPORT SERIES

The Eastport series consists of well drained and moderately well drained Podzols. These soils formed in deep deposits of sand. They are nearly level to steep and are on beach ridges and sand dunes along the shore of Lake Huron. The original vegetation was northern hardwoods and red pine, but oak and aspen are dominant in the second-growth vegetation now on the areas.

These soils are less acid than the Rubicon and Grayling soils. They are less acid and have a less well developed Bir horizon than the Menominee soils, and they also lack the Bt horizon of clay loam that is typical of those soils. Eastport soils are better drained than the Au Gres soils.

Profile of Eastport sand (NE¼NE¼ sec. 2, T. 19 N., R. 7 E.):

A1—0 to 2 inches, very dark gray (10YR 3/1) sand; weak, fine, granular structure; very friable; neutral; abrupt, wavy boundary.
A2—2 to 4 inches, pale-brown (10YR 6/3) sand; very weak, medium, granular structure; very friable; neutral; clear, wavy boundary.
B21ir—4 to 7 inches, dark yellowish-brown (10YR 4/4) sand; very weak, medium, subangular blocky structure; very friable; neutral; clear, irregular boundary.
B22ir—7 to 11 inches, yellowish-brown (10YR 5/6) sand; single grain; loose; neutral; gradual, wavy boundary.
B3—11 to 22 inches, light yellowish-brown (10YR 6/4) sand; single grain; loose; mildly alkaline; gradual, wavy boundary.
C1—22 to 36 inches, brownish-yellow (10YR 6/6) sand; single grain; loose; mildly alkaline; gradual, wavy boundary.
C2—36 inches +, pale-brown (10YR 6/3) sand; single grain; loose; mildly alkaline.

The A1 horizon ranges to very dark brown (10YR 2/2) in color and from 1 to 3 inches in thickness. The color of the A2 horizon ranges to light brownish gray (10YR 6/2), and that of the B21ir horizon to dark yellowish brown (10YR 4/4). In a few places the B21ir horizon contains cemented chunks of ortstein. Mottling occurs below a depth of 30 inches in a few areas. The soils are slightly acid to moderately alkaline. They consist mainly of medium and coarse sand, but thin strata of fine sand and fine gravel are present in some areas.

EDWARDS SERIES

The Edwards series consists of very poorly drained Bog soils. These soils formed from woody and fibrous plant material 12 to 42 inches thick over marl. They are in level to depressional areas on lake and outwash plains. Lowland hardwoods and white-cedars made up the native vegetation.

These soils are deeper to marl than the Warners soils, which have marl within 12 inches of the surface. Depth to marl is less in the Edwards soils than in the Carbondale, which formed in organic deposits more than 42 inches thick.

Profile of Edwards muck NW¼SW¼ sec. 21, T. 19 N., R. 6 E.):

1—0 to 16 inches, black (10YR 2/1) muck; moderate, fine, granular structure; very friable; calcareous; clear, wavy boundary.
2—16 to 22 inches, very dark-brown (10YR 2/2) muck; moderate, medium, granular structure; very friable; calcareous; abrupt, irregular boundary.
IIC1—22 to 36 inches, light brownish-gray (2.5Y 6/2) marl; many, coarse, light-gray (N 7/0) snail shells and dark yellowish-brown (10YR 4/4) root channels; weak, thick, platy structure; friable; calcareous; gradual, wavy boundary.
IIC2—36 to 44 inches +, grayish-brown (2.5Y 5/2) marl; massive; friable; sticky; calcareous.

Where the depth to marl approaches 42 inches, the surface layer in places is mildly alkaline. The marl varies considerably in purity and contains thin layers of muck or mineral material in many places. Wetness of the areas varies from place to place.

EPOUFETTE SERIES

The Epoufette series consists of Humic Gley soils. These soils formed in water-sorted medium and coarse sand, loamy sand, and light sandy loam that overlie calcareous gravel and coarse sand at a depth of 1½ to 3½

feet. They are on level to depressional outwash plains. Stands of white-cedar, black spruce, and lowland hardwoods made up the original vegetation.

These soils are poorly drained to very poorly drained. They are in the same catena as the well drained and moderately well drained Mancelona soils and the somewhat poorly drained Gladwin soils. Epoufette soils are finer textured and more acid in the upper part of the profile than the Tobico soils and contain more gravel. Unlike the Roscommon soils Epoufette soils commonly have a Bt horizon. Epoufette soils formed in coarser sand than the Deford soils.

Profile of Epoufette sandy loam (NW¼NE¼ sec. 25, T. 19 N., R. 5 E.):

Ap—0 to 8 inches, black (10YR 2/1) sandy loam; weak, fine, granular structure; very friable; neutral; abrupt, wavy boundary.

B21—8 to 26 inches, grayish-brown (10YR 5/2) loamy sand; common, medium, distinct mottles of reddish yellow (7.5YR 6/8) and light yellowish brown (10YR 6/4); single grain; very friable; neutral; clear, wavy boundary.

B22g—26 to 32 inches, grayish-brown (10YR 5/2) gravelly sandy loam; common, medium, distinct mottles of reddish yellow (5YR 6/8) and light gray (10YR 7/2); weak, fine, subangular blocky structure; friable; neutral; alkaline; abrupt, wavy boundary.

C—32 to 42 inches +, grayish-brown (10YR 5/2) sand and gravel; a few thin bands or lenses of loamy sand; single grain; calcareous; loose.

The Ap horizon ranges to very dark gray (10YR 3/1) in color and from 5 to 9 inches in thickness. The texture of the B22g horizon ranges from heavy sandy loam to gravelly sandy loam or heavy loamy sand. The C horizon is stratified sand and gravel in places and in other places is dominantly coarse sand. Depth to the C horizon ranges from 22 to 36 inches. Finer textured material is present below a depth of 42 inches in some areas. The profile is slightly acid to mildly alkaline throughout.

ESSEXVILLE SERIES

The Essexville series consists of Humic Gley soils formed in 18 to 42 inches of calcareous sand or loamy sand. These soils are underlain by calcareous loam, sandy clay loam, clay loam, or silty clay loam till. They are on nearly level sand-covered till plains below the lowest beach ridge, mainly near the mouth of Pine River. The native vegetation was mainly willows and alders but included some sedges and marsh grasses.

These soils are similar to the Brevort soils but are calcareous at or within 10 inches of the surface, and those soils have a slightly acid to neutral solum. Essexville soils are also similar to the Pinconning soils, but those soils are slightly acid to neutral throughout the solum and are underlain by silty clay to clay. Essexville soils formed in thinner deposits of sand than the Tobico soils.

Profile of Essexville loamy fine sand (SW¼SE¼ sec. 3, T. 18 N., R. 5 E.):

A1—0 to 9 inches, black (10YR 2/1) loamy fine sand; weak, medium, granular structure; very friable; high in organic matter; calcareous; abrupt, smooth boundary.

C1—9 to 16 inches, light brownish-gray (10YR 6/2) sand; single grain; loose; calcareous; gradual, wavy boundary.

C2—16 to 30 inches, light brownish-gray (10YR 6/2) sand; common, coarse, distinct mottles of dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6); single grain; loose; calcareous; clear, wavy boundary.

C3—30 to 34 inches, gray (10YR 5/1) sand; single grain; loose; calcareous; abrupt, wavy boundary.

IIC4—34 to 42 inches +, gray (10YR 5/1) clay loam; many, fine, distinct mottles of yellowish brown (10YR 5/6 and 5/8), yellow (10YR 7/6), and reddish brown (5YR 5/3); weak, coarse, subangular blocky structure; firm; calcareous.

A layer of muck 2 to 8 inches thick is on the surface in some areas. The A1 horizon ranges to very dark gray (10YR 3/1) in color and from 6 to 9 inches in thickness. The C1, C2, and C3 horizons range from medium sand to fine sand or loamy fine sand in texture. Depth to the IIC4 horizon ranges from 18 to 42 inches. Texture of the IIC4 horizon ranges from clay loam to silty clay loam or sandy clay loam.

GLADWIN SERIES

The Gladwin series consists of soils that have an upper sequum typical of Podzols and a lower sequum typical of Gray Wooded soils. These soils are chiefly on nearly level terraces. They formed in calcareous, stratified sand and gravel that contained a large amount of limestone fragments. A northern hardwood forest that included some hemlocks and white pines made up the native vegetation.

These soils are somewhat poorly drained. They are in the same catena as the well drained and moderately well drained Mancelona soils and the poorly drained to very poorly drained Epoufette. Gladwin soils are similar to the Au Gres soils but those soils lack a lower sequum, typical of Gray Wooded soils, and a B't horizon. They contain more gravel and less fine sand than the Wainola soils and are less acid.

Profile of Gladwin loamy sand (SW¼SW¼ sec. 14, T. 19 N., R. 5 E.):

Ap—0 to 8 inches, very dark gray (10YR 3/1) loamy sand; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

A2—8 to 12 inches, pale-brown (10YR 6/3) sand; very weak, thin, platy structure; very friable; slightly acid; abrupt, wavy boundary.

Bir—12 to 23 inches, strong-brown (7.5YR 5/6) loamy sand; common, medium, distinct mottles of gray (10YR 6/1), dark brown (10YR 4/3), and light brown (7.5YR 6/4); weak, fine, subangular blocky structure; very friable; slightly acid; clear, wavy boundary.

B't—23 to 29 inches, light yellowish-brown (10YR 6/4) gravelly sandy loam; common, medium, distinct mottles of gray (10YR 6/1) and very dark brown (10YR 2/2); weak, medium, subangular blocky structure; friable; mildly alkaline; abrupt, wavy boundary.

C—29 inches +, pale-brown (10YR 6/3) sand and gravel; stratified; single grain; loose; calcareous.

In undisturbed areas there is a black (10YR 2/1) A1 horizon 2 to 4 inches thick. The upper part of the Bir horizon is only faintly mottled in some areas. A light brownish-gray (10YR 6/2) A2 horizon occurs between the Bir and the B't horizons in some areas, especially where depth to loose sand and gravel is nearly 42 inches. The B't horizon is sandy loam or heavy loamy sand in places. Its thickness ranges from 4 to 12 inches. The solum is slightly acid to mildly alkaline. The proportion of sand and gravel in the C horizon varies within a short distance, both horizontally and vertically.

GRAYLING SERIES

The Grayling series consists of well drained and moderately well drained Brown Podzolic soils. These soils formed in deep deposits of sand under forests made up mainly of scrub oak and jack pine but that included a few red pine. Most areas are in the Ogemaw State Forest.

The B horizon of these soils is darker colored than that of the Rubicon or Eastport soils. Grayling soils are better drained than the Au Gres soils and lack the clay loam Bt horizon typical of the Menominee soils. They are less stratified and coarser textured than the Rousseau soils.

Profile of Grayling sand (SE. corner of NE¼, sec. 16, T. 19 N., R. 4 E.):

A1—0 to 1½ inches, black (10YR 2/1) sand; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.
A2—1½ to 5 inches, brown (7.5YR 4/2) medium sand; weak, fine, granular structure; very friable; slightly acid; clear, wavy boundary.
B21ir—5 to 11 inches, yellowish-brown (10YR 5/4) medium sand; very weak, fine, granular structure; very friable; medium acid; clear, wavy boundary.
B22ir—11 to 23 inches, yellowish-brown (10YR 5/6) medium sand; single grain; loose; medium acid; clear, wavy boundary.
C—23 to 60 inches +, light yellowish-brown (10YR 6/4) coarse sand; single grain; loose; slightly acid.

The A2 horizon ranges to light brownish gray (10YR 6/2), and the Bir horizon ranges to brown (10YR 5/3). In most areas the profile is dominantly medium sand, but strata of coarse or fine sand are present in some places. Thin bands of loamy sand 1/16 to 2 inches thick are in the C horizon at a depth below 60 inches in some areas. In places the C horizon is mottled below a depth of 24 inches. The profile is slightly acid to strongly acid throughout.

GREENWOOD SERIES

In the Greenwood series are Bog soils formed in extremely acid peat derived chiefly from sphagnum moss, other mosses, and fibrous sedges. The organic material is more than 42 inches thick. These soils occur in depressions or basinlike areas. The original vegetation was mainly sphagnum moss and leatherleaf but included a few tamarack and black spruce.

The Greenwood soils are more acid and less decomposed than the Rifle soils. They are closely associated with the Dawson soils but formed in thicker organic deposits.

Profile of Greenwood peat:

1—0 to 4 inches, dark grayish-brown (10YR 4/2) sphagnum moss peat; massive; nonsticky; extremely acid; clear, wavy boundary.
2—4 to 9 inches, dark reddish-brown (5YR 3/4) fibrous peat; massive; spongy when wet and nonsticky; extremely acid; gradual, smooth boundary.
3—9 to 44 inches +, yellowish-brown (10YR 5/6) fibrous peat; weak, thick, platy structure; extremely acid.

In some areas a horizon of mineral material is at a depth of more than 42 inches. The profile is strongly acid to extremely acid. The amount and degree of identifiable plant remains vary from place to place.

HETTINGER SERIES

Soils of the Hettinger series are in the Humic Gley great soil group. These soils formed mostly in stratified clay loam and silty clay loam but partly in silt, silty clay, and very fine sand. They are on nearly level lake plains. The original vegetation was stands made up chiefly of elm, ash, and aspen but that also included some white pine and hemlock.

These soils have a coarser textured solum than the Bergland and Pickford soils and a finer textured solum than the Bruce soils. Hettinger soils are stratified and have a more variable solum than the Sims soils.

Profile of Hettinger clay loam (SE¼SW¼ sec. 11, T. 20 N., R. 3 E.):

A1—0 to 6 inches, very dark grayish-brown (10YR 3/2) clay loam; moderate, medium, granular structure; friable; neutral; clear, wavy boundary.
Bg—6 to 20 inches, gray (10YR 5/1) clay loam and silty clay loam; moderate, fine, angular blocky structure; firm; mildly alkaline; gradual, wavy boundary.
C—20 to 42 inches +, pale-brown (10YR 6/3), stratified clay loam and silty clay loam; thin strata of clay, loam, and very fine sand; common, medium, distinct mottles of yellowish-brown (10YR 5/8), light brownish gray (10YR 6/2), and brownish yellow (10YR 6/6); massive; firm; calcareous.

In some areas a layer of muck 2 to 6 inches thick is on the surface. Cultivated areas have a black (10YR 2/1) Ap horizon 6 to 9 inches thick. The surface layer is clay loam, loam, or silty clay loam. The A1 horizon ranges to black (10YR 2/1) in color and from 5 to 8 inches in thickness. The Bg horizon ranges from clay loam to silty clay loam and contains thin strata of loam, silt, clay, and very fine sand. It is mottled in some areas in the lower part. The frequency of the thin strata of silt and very fine sand in the Bg horizon varies, but the areas where they occur are minor.

INGALLS SERIES

The Ingalls series consists of Podzols formed in loamy sand or sand 18 to 42 inches thick. These soils are underlain by stratified very fine sand and silt. Forests of red and white pine and northern hardwoods made up the original vegetation.

These soils are somewhat poorly drained. They are in the same catena as the poorly drained and very poorly drained Burleigh soils. Their solum is similar to that of the Iosco and Allendale soils, but those soils are underlain by loam to silty clay loam, or clay to silty clay, respectively. Ingalls soils are similar to the Au Gres soils, but those soils are underlain by medium and coarse sand. The upper part of their solum is coarser textured than that of the Brimley soils. Ingalls soils lack the lower Gray Wooded sequum typical of the Brimley soils.

Profile of Ingalls loamy sand (NW¼NE¼ sec. 2, T. 19 N., R. 4 E.):

A1—0 to 3 inches, very dark brown (10YR 2/2) loamy sand; weak, medium, granular structure; very friable; slightly acid; abrupt, smooth boundary.
A2—3 to 10 inches, grayish-brown (10YR 5/2) loamy sand; single grain; loose; slightly acid; abrupt, wavy boundary.
B21hir—10 to 18 inches, dark reddish-brown (5YR 3/4) sand; many, fine, distinct mottles of yellowish brown (10YR 5/8); very weak, medium, subangular blocky structure; very friable; neutral; gradual, wavy boundary.
B22ir—18 to 30 inches, dark-brown (7.5YR 4/4) loamy sand; many, fine, distinct mottles of yellowish brown (10YR 5/8); very weak, medium, subangular blocky structure; very friable; neutral; clear, wavy boundary.

IIC—30 to 42 inches +, brown (7.5YR 5/4), stratified very fine sand and silt, and thin layers of silt loam and silty clay loam; sand is single grain and loose, but silt is massive and friable; calcareous.

Cultivated areas have a very dark gray (10YR 3/1) Ap horizon 6 to 10 inches thick. The B21hir horizon ranges to dark brown (7.5YR 4/4) in color. It contains chunks of cemented material (ortstein) in some places. The color of the B22ir horizon ranges to dark yellowish brown (10YR 4/4). In the upper part of the profile, the texture ranges from sand to loamy sand. The IIC horizon is dominantly stratified very fine sand and silt, but in many areas it contains thin layers of silt loam, sand, and sandy loam ⅛ to 4 inches thick. Depth to free carbonates is generally the same as to the IIC horizon, but in some places the upper few inches of the IIC horizon is mildly alkaline. The solum ranges from medium acid to neutral.

IOSCO SERIES

Soils of the Iosco series have an upper sequum typical of Podzols and a lower sequum typical of Gray Wooded soils. These soils formed in sand or loamy sand 18 to 42 inches thick over loam to silty clay loam. They are on low ridges and broad, level, sandy lake and till plains. Stands of white pines and northern hardwoods made up the original vegetation, and these trees are dominant in the present cover.

These soils are somewhat poorly drained. They are in the same catena as the well drained and moderately well drained Menominee soils and the poorly drained and very poorly drained Brevort. Iosco soils are similar to the Allendale and Ingalls soils, but their substratum is more loamy.

Profile of Iosco loamy sand (SE¼SW¼ sec. 17, T. 18 N., R. 4 E.):

O1—2 inches to 0 of leaf litter and peaty material.
A1—0 to 2 inches, very dark brown (10YR 2/2) loamy sand; very weak, fine, granular structure; very friable; medium acid; abrupt, wavy boundary.
A2—2 to 8 inches, light-gray (10YR 7/2) loamy sand; very weak, coarse, granular structure; very friable; medium acid; abrupt, wavy boundary.
Bir—8 to 28 inches, dark yellowish-brown (10YR 4/4) loamy sand; weak, fine, subangular blocky structure; very friable; medium acid; clear, wavy boundary.
A'2—28 to 32 inches, grayish-brown (10YR 5/2) loamy sand; common, medium, distinct mottles of strong brown (7.5YR 5/6); single grain; loose; slightly acid; abrupt, irregular boundary.
IIB'tg—32 to 37 inches, grayish-brown (10YR 5/2) clay loam; common, medium, distinct mottles of yellowish brown (10YR 5/6); weak, coarse, subangular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.
IIC—37 to 42 inches +, grayish-brown (10YR 5/2) clay loam; common, medium, distinct mottles of yellowish brown (10YR 5/6); massive; firm; calcareous.

In cultivated areas the O1 and A1 horizons and part of the A2 horizon have been mixed together by plowing to form a very dark gray (10YR 3/1) Ap horizon 6 to 9 inches thick. The color of the Bir horizon ranges to dark brown (7.5YR 4/4). In places, material similar to that in the A'2 horizon is in the upper part of the IIB'tg horizon as thick coatings on the peds. The IIB'tg horizon ranges from clay loam to silty clay loam, or heavy loam, in texture and from 2 to 12 inches in thickness. The IIC horizon ranges from clay loam to sandy clay loam or silty clay loam. The Podzol sequum ranges from medium acid to slightly acid, and the Gray Wooded sequum from slightly acid to mildly alkaline.

ISABELLA SERIES

The Isabella series consists of soils that have an upper sequum typical of Podzols and a lower sequum typical of Gray Wooded soils. These soils formed in sandy clay loam or clay loam till. They are mainly on moraines in the northern part of the county. Stands of northern hardwoods and white pines made up the original vegetation.

These soils are well drained and moderately well drained. They are in the same catena as the somewhat poorly drained Twining soils and the poorly drained and very poorly drained Sims soils. They are similar to the Nester soils, but those soils lack a Podzol upper sequum. Isabella soils are finer textured throughout the profile than the Bohemian soils.

Profile of Isabella sandy loam (NW¼NE¼ sec. 25, T. 20 N., R. 4 E.):

Ap—0 to 8 inches, gray (10YR 5/1) sandy loam; weak, fine, granular structure; friable; mildly alkaline; abrupt, smooth boundary.
Bir—8 to 10 inches, brown (7.5YR 5/4) sandy loam; medium granular structure; friable; medium acid; clear, irregular boundary.
A'2—10 to 12 inches, light brownish-gray (10YR 6/2) sandy loam; weak, medium, platy structure; friable; medium acid; clear, irregular boundary.
A'2 & B'21t—12 to 14 inches, light brownish-gray (10YR 6/2) sandy loam similar to that in the A'2 horizon and reddish-brown (5YR 4/3) heavy loam representing the B'21t horizon; moderate, medium, subangular blocky structure; firm; brittle; slightly acid; weak fragipan; clear, wavy boundary.
B'22t—14 to 20 inches, dark-brown (7.5YR 4/4) heavy clay loam; moderate, medium, angular blocky structure; firm; slightly acid; many clay coatings; gradual, smooth boundary.
B'23t—20 to 32 inches, reddish-brown (5YR 4/4) clay loam; moderate, medium, angular blocky structure; firm; neutral; abrupt, wavy boundary.
C—32 inches +, brown (7.5YR 4/4) sandy clay loam; weak, medium, angular blocky structure; firm; calcareous.

Undisturbed areas have a very dark gray (10YR 3/1) A1 horizon, 1 to 3 inches thick. The Ap horizon ranges to dark grayish brown (10YR 4/2) in color and from 6 to 9 inches in thickness. An A2 horizon that is light brownish gray (10YR 6/2) and 4 to 7 inches thick is in the undisturbed areas. This horizon ranges from 1 to 3 inches in thickness in many cultivated areas. The Bir horizon ranges to dark brown (7.5YR 4/4) or dark yellowish brown (10YR 4/4) in color and from 2 to 5 inches in thickness. The A'2 & B'21t horizon is a weak to moderate fragipan and ranges from 2 to 8 inches in thickness. The B't ranges to reddish brown (5YR 4/4) in color and from clay loam to sandy clay loam in texture. Depth to the C horizon ranges from 25 to 42 inches. Texture of the C horizon ranges to sandy clay loam. The solum ranges from slightly acid to mildly alkaline.

KAWKAWLIN SERIES

The Kawkawlin series consists of Gray Wooded soils formed in calcareous till of clay loam or silty clay loam. These soils are on broad till plains and in nearly level to slight depressions in moraines. The original vegetation was mainly hardwood forests, in which sugar maple,

red oak, and aspen were dominant, but swamp hardwoods were included in the wetter areas.

The Kawkawlin soils are somewhat poorly drained. They are in the same catena as the well drained or moderately well drained Nester soils and the poorly drained or very poorly drained Sims soils. The glacial till in which the Kawkawlin soils formed contains more silt and clay and less sand than that in which the Twining soils formed. Kawkawlin soils lack the Podzol upper sequum typical of the Twining soils. They are coarser textured than the Selkirk soils, and their B and C horizons are more uniform in texture than those of the Bowers soils.

Profile of Kawkawlin loam (SW¼SW¼ sec. 19, T. 18 N., R. 5 E.):

Ap—0 to 6 inches, very dark gray (10YR 3/1) loam; moderate, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.
A2—6 to 10 inches, pale-brown (10YR 6/3) loam; moderate, medium, platy structure; friable; slightly acid; clear, wavy boundary.
A2 & B21—10 to 12 inches, pale-brown (10YR 6/3) loam representing the A2 horizon and dark-brown (7.5YR 4/4) heavy loam representing the B21 horizon; the material representing the A2 horizon occurs as thick coatings on peds and in cracks; moderate, medium, subangular blocky structure; firm; neutral; clear, irregular boundary.
B22—12 to 22 inches, dark-brown (7.5YR 4/4) heavy clay loam; many, coarse, distinct mottles of yellowish brown (10YR 5/4) and pale brown (10YR 6/3); strong, medium, angular blocky structure; firm; neutral; abrupt, wavy boundary.
C—22 to 42 inches +, brown (7.5YR 5/4) clay loam; many, coarse, distinct mottles of light yellowish brown (10YR 6/4) and light brownish gray (10YR 6/2); weak, coarse, angular blocky structure; firm; calcareous.

Undisturbed areas have a very dark gray (10YR 3/1) A1 horizon 1 to 3 inches thick. The Ap horizon ranges to dark grayish brown (10YR 3/2) in color and from 6 to 9 inches in thickness. Material from the A2 horizon is in the upper part of the B horizon in places as thick coatings on peds and in cracks. The matrix of the B horizon ranges to brown (7.5YR 5/2) in color and to silty clay loam in texture. The solum ranges from 16 to 30 inches in thickness. The texture of the C horizon ranges from clay loam to silty clay loam. The solum is slightly acid to mildly alkaline.

KENT SERIES

In the Kent series are Gray Wooded soils formed in till consisting of silty clay to clay. Stands of northern hardwoods and white pines made up the original vegetation.

These soils are well drained and moderately well drained. They are in the same catena as the somewhat poorly drained Selkirk soils, the poorly drained Pickford, and the very poorly drained Bergland.

Profile of Kent loam (NW¼NE¼ sec. 30, T. 19 N., R. 5 E.):

Ap—0 to 6 inches, very dark gray (10YR 3/1) loam; moderate, fine, granular structure; friable; neutral; abrupt, smooth boundary.
A2—6 to 8 inches, pale-brown (10YR 6/3) loam; weak, medium, platy structure; friable; neutral; clear, irregular boundary.
A2 & B21—8 to 11 inches, pale-brown (10YR 6/3) loam similar to that in the A2 horizon and reddish-brown (5YR 4/4) clay representing the B21 horizon; moderate, medium, subangular blocky structure; firm; neutral; clear, irregular boundary.
B22—11 to 22 inches, reddish-brown (5YR 4/4) clay; strong, medium, angular blocky structure; very firm; mildly alkaline; clear, wavy boundary.
C—22 to 42 inches +, brown (7.5YR 4/4) clay; moderate, medium, angular blocky structure; very firm when moist, sticky when wet; calcareous.

Undisturbed areas have a very dark gray (10YR 3/1) A1 horizon 1 to 3 inches thick. The Ap horizon ranges to dark grayish brown (10YR 4/2) in color and from 5 to 8 inches in thickness. Material from the A2 horizon thickly coats peds and cracks in the upper part of the B horizon in some areas. The B horizon ranges to dark brown (7.5YR 4/4) in color. The solum ranges from 16 to 28 inches in thickness.

LACOTA SERIES

The Lacota soils are in the Humic Gley great soil group. These soils are in level to depressional areas. They formed in clay loam or silty clay loam underlain by calcareous sand or loamy sand. The native vegetation was a forest of oak, elm, ash, and red maple.

Lacota soils are similar to the Hettinger, Sims, and Wisner soils, but unlike those soils have sand at a depth of 18 to 42 inches. Their solum is finer textured than that of the Epoufette and Saganing soils.

Profile of Lacota loam (NE¼NE¼ sec. 15, T. 20 N., R. 6 E.):

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam; moderate, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.
B21g—8 to 16 inches, gray (10YR 5/1) clay loam; common, medium, distinct mottles of yellowish brown (10YR 5/6); moderate, medium, angular blocky structure; firm; neutral; gradual, wavy boundary.
B22g—16 to 34 inches, gray (10YR 5/1) clay loam; common, coarse, distinct mottles of yellowish brown (10YR 5/4) and yellowish red (5YR 4/6); moderate, coarse, angular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.
IIC—34 inches +, light brownish-gray (10YR 6/2) sand; single grain; loose; calcareous.

The Ap, or A horizon, ranges from 7 to 12 inches in thickness, and where it is thickest is underlain by a very dark gray to black A12 horizon. The B21g horizon is dominantly gray and has little or no mottling in some areas. The B horizon ranges from clay loam to silty clay loam or sandy clay loam. Depth to the IIC horizon ranges from 18 to 42 inches but is dominantly from 20 to 36 inches. The IIC horizon ranges from sand to loamy sand in texture and contains thin layers of sandy loam in some areas.

LINWOOD SERIES

The Linwood series consists of Bog soils formed in organic material 12 to 42 inches thick over heavy sandy loam to light silty clay loam. These soils are in level to depressional areas on lake, outwash, and till plains. The original vegetation was mainly forests of ash, elm, white birch, white-cedar, and fir but included some alder and willow in the wetter areas. Most areas are wooded.

Linwood soils formed in shallower organic deposits than the Carbondale soils. They are similar to the Tawas and Willette soils, but Tawas soils are underlain by sand to loamy sand and Willette soils by heavy silty clay loam to clay at a depth of 12 to 42 inches.

Profile of Linwood muck:

1—0 to 7 inches, very dark brown (10YR 2/2) muck; moderate, fine, granular structure; friable; neutral; gradual, wavy boundary.
2—7 to 14 inches, black (10YR 2/1) muck; moderate, very coarse, granular structure; friable; slightly acid; gradual, wavy boundary.
3—14 to 19 inches, very dark gray (10YR 3/1) muck; moderate, medium, granular structure; friable; neutral; clear, wavy boundary.
IIC1—19 to 21 inches, very dark gray (10YR 3/1) mucky clay loam; moderate, medium, subangular blocky structure; firm; calcareous; clear, wavy boundary.
IIC2—21 to 42 inches +, grayish-brown (10YR 5/2) clay loam; weak, medium, subangular blocky structure; firm; calcareous.

In some areas the organic horizons are peat or peaty muck. Pieces of wood are commonly scattered throughout the organic horizons. The IIC horizon ranges from mucky clay loam to heavy sandy loam or silty clay loam in texture. The organic material ranges from medium acid to neutral. In places the IIC1 horizon is mildly alkaline.

MANCELONA SERIES

Soils of the Mancelona series have an upper sequum typical of Podzols and a lower sequum typical of Gray Wooded soils. These soils formed in calcareous sandy and gravelly outwash on terraces and beach ridges. Stands of northern hardwoods and red and white pines made up the original vegetation.

Mancelona soils are well drained and moderately well drained. They are in the same catena as the somewhat poorly drained Gladwin soils and the poorly drained and very poorly drained Epoufette soils. They are similar to the Rousseau and Rubicon soils, but those soils lack a Gray Wooded lower sequum and a B′t horizon.

Profile of Mancelona loamy sand (SW¼ sec. 19, T. 20 N., R. 4 E.):

A1—0 to 1 inch, very dark gray (10YR 3/1) loamy sand; very weak, granular structure; very friable; slightly acid; abrupt, wavy boundary.
A2—1 to 4 inches, brown (10YR 5/3) sand; very weak, fine, granular structure; very friable; medium acid; abrupt, wavy boundary.
B21ir—4 to 8 inches, strong-brown (7.5YR 5/6) sand; very weak, coarse, granular structure; very friable; medium acid; clear, wavy boundary.
B22ir—8 to 13 inches, dark-brown (7.5YR 4/4) loamy sand; weak, medium, granular structure; very friable; slightly acid; clear, wavy boundary.
B23ir—13 to 20 inches, strong-brown (7.5YR 5/6) sand; single grain; loose; slightly acid; gradual, wavy boundary.
B3—20 to 25 inches, strong-brown (7.5YR 5/6) gravelly sand; single grain; loose; slightly acid; clear, wavy boundary.
B′t—25 to 33 inches, dark-brown (7.5YR 4/4) gravelly sandy loam; weak, medium, subangular blocky structure; friable; neutral; abrupt, wavy boundary.
C—33 to 60 inches +, yellowish-brown (10YR 5/4), stratified sand and gravel; single grain; loose; calcareous.

Cultivated areas have a very dark grayish-brown (10YR 3/2) Ap horizon 6 to 10 inches thick. The A2 horizon ranges to light brownish gray (10YR 6/2) in color and from 1 to 6 inches in thickness. The Bir horizon ranges to dark yellowish brown (10YR 4/4) in color and from 4 to 12 inches in thickness. A pale-brown (10YR 6/3) A′2 horizon 1 to 3 inches thick is above the B′t horizon in places. Texture of the B′t horizon ranges from gravelly sandy loam to heavy loamy sand, and thickness ranges from 4 to 12 inches. The B′t horizon consists of layers, 2 to 4 inches thick, separated in some places by layers of material from the A′2 horizon that are 1 to 3 inches thick. The solum ranges from medium acid to neutral. The C horizon is stratified sand and gravel or is coarse sand.

MANISTEE SERIES

Manistee soils have an upper sequum typical of Podzols and a lower sequum typical of Gray Wooded soils. These soils formed in 18 to 42 inches of sand or loamy sand over silty clay or clay. They are mainly in small areas where sand has been deposited on lacustrine clay or clay till. The original vegetation was mainly northern hardwoods but included a few white pines.

These soils are well drained and moderately well drained. They are in the same catena as the somewhat poorly drained Allendale soils and the poorly drained and very poorly drained Pinconning. Their solum is similar to that of Menominee soils, but those soils are underlain by loam to silty clay loam. Manistee soils formed in shallower deposits of sand than the Rubicon soils, which are underlain by loam to clay at a depth of more than 42 inches.

Profile of Manistee loamy sand (NW¼SW¼ sec. 31, T. 19 N., R. 5 E.):

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.
A2—8 to 12 inches, pinkish-gray (7.5YR 6/2) sand; very weak, fine, granular structure; loose; slightly acid; abrupt, wavy boundary.
Bir—12 to 24 inches, brown (7.5YR 4/4) loamy sand; weak, medium, subangular blocky structure; very friable; slightly acid; clear, wavy boundary.
A′2—24 to 34 inches, yellowish-brown (10YR 5/4) sand; very weak, medium, subangular blocky structure; very friable; slightly acid; gradual boundary.
IIBt—34 to 40 inches, reddish-brown (5YR 5/3) clay; moderate, medium, angular blocky structure; very firm; very plastic; neutral; clear, wavy boundary.
IIC—40 inches +, brown (7.5YR 5/4) clay; moderate, medium, angular blocky structure; very firm; calcareous.

Undisturbed areas have a very dark gray (10YR 3/1) A1 horizon 1 to 4 inches thick. The color of the Ap horizon ranges to dark grayish brown (10YR 4/2). In some areas where the thickness of the Ap horizon exceeds 9 inches, the A2 horizon is absent. The color of the Bir horizon ranges to strong brown (7.5YR 5/6) or reddish brown (5YR 4/4), and that of the A′2 horizon ranges to grayish brown (10YR 5/2). The A′2 horizon is absent or occurs as thick coatings on peds in some areas. Thickness of the B′t horizon ranges from 2 to 10 inches. The IIC horizon is silty clay or clay glacial till or consists of lacustrine deposits. Mottling is present in the IIC horizon in many places. The Podzol sequum ranges from strongly acid to slightly acid, and the Gray Wooded sequum from slightly acid to mildly alkaline.

MARKEY SERIES

The Markey series consists of Bog soils formed in the remains of coniferous and deciduous woody plants and sedges 12 to 42 inches thick. These soils are underlain by mildly alkaline to calcareous sand. They are in level to depressional areas on outwash plains. The original

vegetation was lowland hardwoods and white-cedar, black spruce, and other conifers.

Markey soils formed in shallower deposits of organic material than the Carbondale soils, which formed in organic material more than 42 inches thick. They are less acid than the Tawas and Adrian soils.

Profile of Markey muck:

Ap—0 to 7 inches, black (10YR 2/1) muck; weak; medium, granular structure; contains variable amounts of woody remains from plants; friable; mildly alkaline; abrupt, smooth boundary.
2—7 to 14 inches, black (10YR 2/1) muck; weak, medium, granular structure; friable; mildly alkaline; gradual, irregular boundary.
3—14 to 30 inches, yellowish-brown (10YR 5/4) peat; massive; friable; remains of plant can be distinguished; mildly alkaline; abrupt, irregular boundary.
IIC—30 to 42 inches +, light brownish-gray (10YR 6/2) sand; single grain; loose; calcareous.

The third layer is muck in some areas. The content of woody material in the organic material varies but generally is noticeable. The IIC horizon ranges from sand to loamy sand. The organic part of the profile is mildly alkaline to moderately alkaline.

MAUMEE SERIES

Soils of the Maumee series are in the Humic Gley great soil group. These soils formed in loamy sand or sand. Willow, tag alder, and marsh grasses made up the original vegetation. Maumee soils have a thicker and darker A1 horizon than the Roscommon, Tobico, Deford, and Epoufette soils.

Profile of Maumee mucky loamy sand (¼ mile E. of SW. corner of sec. 10, T. 20 N., R. 6 E.):

Ap—0 to 10 inches, black (10YR 2/1) mucky loamy sand; weak, fine, granular structure; very friable; mildly alkaline; abrupt, smooth boundary.
A12—10 to 18 inches, black (10YR 2/1) mucky loamy sand; weak, fine, granular structure; very friable; mildly alkaline; abrupt, irregular boundary.
C1—18 to 28 inches, pale-brown (10YR 6/3) sand; contains thin bands of silt loam; weak, thin, platy structure; very friable; moderately alkaline; clear, wavy boundary.
C2—28 to 34 inches, light yellowish-brown (10YR 6/4) sand; single grain; loose; moderately alkaline; clear, wavy boundary.
C3—34 to 42 inches +, light brownish-gray (2.5Y 6/2) sand; single grain; loose; calcareous.

A layer of muck 6 to 12 inches thick is on the surface in some areas. The A12 horizon ranges from 4 to 12 inches in thickness. In the C1 horizon in some areas, the thin layers of silt loam are lacking. The profile in most places ranges from neutral to moderately alkaline, but it is calcareous in a few areas.

MENOMINEE SERIES

Soils of the Menominee series have an upper sequum typical of Podzols and a lower sequum typical of Gray Wooded soils. These soils formed in sand or loamy sand 18 to 42 inches thick over loam to silty clay loam or clay loam. They are on the tops and sides of moraines, and on high, sand-covered till plains. Stands of northern upland hardwoods and white pines made up the original vegetation.

These soils are well drained to moderately well drained. They are in the same catena as the somewhat poorly drained Iosco soils and the poorly drained and very poorly drained Brevort. Their solum is similar to that of the Manistee soils, but those soils are underlain by silty clay to clay. Menominee soils formed in shallower sandy deposits than the Rubicon soils.

Profile of Menominee loamy sand (SW. corner of NW¼ sec. 21, T. 20 N., R. 4 E.):

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, fine, granular structure; very friable; strongly acid; abrupt, smooth boundary.
A2—8 to 11 inches, pinkish-gray (7.5YR 7/2) sand; single grain; loose; strongly acid; abrupt, smooth boundary.
B21ir—11 to 17 inches, dark yellowish-brown (10YR 4/4) sand; very weak, medium, subangular blocky structure; very friable; strongly acid; gradual, wavy boundary.
B22ir—17 to 32 inches, dark-brown (7.5YR 4/4) sand; single grain; loose; strongly acid; abrupt, irregular boundary.
A'2—32 to 40 inches, pale-brown (10YR 6/3) sand; single grain; loose; medium acid; abrupt, irregular boundary.
IIB't—40 to 45 inches, reddish-brown (5YR 4/3) clay loam; moderate, fine, subangular blocky structure; pale-brown (10YR 6/3) sand coatings and fillings on and in cracks; mildly alkaline; abrupt, wavy boundary.
IIC—45 inches +, reddish-brown (5YR 4/3) clay loam; moderate, medium, subangular blocky structure; firm; calcareous.

Undisturbed areas have a very dark gray (10YR 3/1) A1 horizon 1 to 3 inches thick. In areas where the depth of plowing is 10 inches or more, the Ap horizon is a mixture of the original A0 and A1 horizons and part of the A2 horizon. The A2 horizon is very thin and in places is lacking. In places the thickness of the Ap horizon is more than 8 inches, and here the B21ir horizon ranges to dark brown (7.5YR 4/4) in color and from 4 to 10 inches in thickness. The B22ir horizon ranges to yellowish brown (10YR 5/4) in color. Chunks of cemented material (ortstein) are in the Bir horizon in some areas.

The A'2 horizon ranges from 1 to 10 inches in thickness, and tongues of it reach into the IIB' horizon in most areas. The IIB' horizon ranges from 4 to 8 inches in thickness, and to heavy loam or silty clay loam in texture. The texture of the IIC horizon ranges from clay loam to heavy loam or silty clay loam.

The Podzol sequum and the A'2 horizon range from strongly acid to slightly acid but are dominantly strongly acid to medium acid. The IIB' horizon ranges from slightly acid to mildly alkaline.

NESTER SERIES

The Nester series consists of Gray Wooded soils formed in calcareous clay loam or silty clay loam till. These soils are mainly on the Port Huron moraine in the northwestern part of the county. Stands of northern hardwoods, hemlocks, and white pines made up the original vegetation.

These soils are well drained and moderately well drained. They are in the same catena as the somewhat poorly drained Kawkawlin soils and the poorly drained and very poorly drained Sims soils. The till in which they formed contains more silt and clay and less sand than that in which the Isabella soils formed. Nester soils are similar to the Isabella soils but lack the upper Podzol sequum that is typical of those soils. Their B

and C horizons are coarser textured than those in the Kent soils.

Profile of Nester fine sandy loam (NE¼NW¼ sec. 29, T. 20 N., R. 4 E.):

A1—0 to 4 inches, very dark gray (10YR 3/1) fine sandy loam; moderate, medium, granular structure; friable; neutral; abrupt, smooth boundary.

A2—4 to 8 inches, pale-brown (10YR 6/3) fine sandy loam; moderate, thick, platy structure; friable; neutral; abrupt, irregular boundary.

A2 & B21—8 to 10 inches, pale-brown (10YR 6/3) fine sandy loam similar to that in the A2 horizon and reddish-brown (5YR 4/3) clay loam, representing the B21 horizon; the A2 horizon is present as tongues and thick coatings on peds and in cracks; moderate, medium, subangular blocky structure; firm; slightly acid; gradual, wavy boundary.

B22—10 to 28 inches, reddish-brown (5YR 4/3) heavy clay loam; a few pale-brown (10YR 6/3) coatings in the upper 2 inches; dark, thin, reddish-brown (5YR 3/2) coatings on ped surfaces; strong, medium, angular blocky structure; firm; slightly acid; abrupt, wavy boundary.

C1—28 to 50 inches +, brown (7.5YR 5/4) clay loam; moderate, medium, angular blocky structure; firm; calcareous.

Cultivated areas have a very dark grayish-brown (10YR 3/2) or dark grayish-brown (10YR 4/2) Ap horizon 6 to 10 inches thick. The A2 horizon is thin or lacking in some cultivated areas, especially where the Ap horizon is 8 or more inches thick. The B horizon ranges to dark brown (7.5YR 4/4) in color. Its texture ranges from heavy clay loam to silty clay loam or light clay. The lower part of the B horizon is mottled in some areas. Depth to the C1 horizon ranges from 20 to about 40 inches. The texture of the C1 horizon ranges from clay loam to silty clay loam.

PICKFORD SERIES

The Pickford series consists of Humic Gley soils formed in clay or silty clay. These soils are on broad lake plains and in some depressions in till plains. Stands of soft maple, elm, hemlock, white-cedar, and spruce made up the original vegetation.

These soils are poorly drained. They are in the same catena as the well drained and moderately well drained Kent soils and the somewhat poorly drained Selkirk. Pickford soils are finer textured than the Hettinger and Sims soils. They are similar to the Charity soils, but those soils are calcareous at or near the surface.

Profile of Pickford silty clay loam (SW¼NW¼ sec. 21, T. 20 N., R. 6 E):

Ap—0 to 6 inches, black (10YR 2/1) silty clay loam; moderate, medium, granular structure; firm; neutral; abrupt, smooth boundary.

B21g—6 to 13 inches, grayish-brown (2.5Y 5/2) silty clay; common, medium, distinct mottles of strong brown (7.5YR 5/6); strong, medium, angular blocky structure; very firm when moist, sticky when wet; neutral; gradual, smooth boundary.

B22g—13 to 30 inches, light brownish-gray (2.5Y 6/2) clay; common, medium, distinct mottles of brown (7.5YR 5/4); strong, medium, angular blocky structure; very firm when moist, very sticky when wet; mildly alkaline; abrupt, wavy boundary.

C—30 to 42 inches +, light brownish-gray (2.5Y 6/2) clay; common, medium, distinct mottles of brown (7.5YR 5/4); massive; very firm when moist, sticky when wet; calcareous.

Some undisturbed areas have a surface layer of muck 2 to 10 inches thick. The Ap horizon, or the Ap and A12 horizons, ranges from 5 to 8 inches in thickness. The B horizon ranges to grayish brown (10YR 5/2) in color. The B and C horizons range from silty clay to clay in texture. Thin layers of silt are in the lower B horizon and in the C horizon in some places. Depth to the C horizon ranges from 15 to 30 inches. The Ap horizon is medium acid to neutral, and the reaction of the B horizon ranges from slightly acid to mildly alkaline.

PINCONNING SERIES

The Pinconning soils are in the Humic Gley great soil group. These soils consist of 18 to 42 inches of loamy sand or sand underlain by calcareous silty clay or clay. They are in nearly level areas on lake plains and in small depressions and drainageways on moraines. The original vegetation was lowland hardwoods and conifers. These soils are poorly drained and very poorly drained. They are in the same catena as the well drained and moderately well drained Manistee soils and the somewhat poorly drained Allendale. Pinconning soils are similar to Brevort soils, but those soils are underlain by clay loam or silty clay loam. They are also similar to Roscommon soils, which formed in sandy deposits more than 42 inches thick.

Profile of Pinconning loamy sand (NW¼NE¼ sec. 2, T. 18 N., R. 4 E.):

Ap—0 to 7 inches, very dark gray (10YR 3/1) loamy sand; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

C1—7 to 12 inches, grayish-brown (10YR 5/2) loamy sand; very weak, medium, granular structure; very friable; slightly acid; gradual, wavy boundary.

C2—12 to 30 inches, very pale brown (10YR 7/3) loamy sand; common, coarse, distinct mottles of dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6); single grain; loose; neutral; abrupt, wavy boundary.

IIC3—30 inches, reddish-brown (5YR 5/3) clay; common, medium, distinct mottles of dark reddish brown (5YR 3/3), pale brown (10YR 6/3), and light gray (10YR 7/2); weak, fine, angular blocky structure; very firm; calcareous.

Some undisturbed areas have a layer of muck on the surface 2 to 6 inches thick. The Ap horizon ranges from 5 to 10 inches in thickness. Texture in the upper part of the profile ranges from loamy sand to sand, but that in the IIC3 horizon ranges from silty clay to clay. Depth to the IIC3 horizon ranges from 18 to about 42 inches. The sandy part of the profile is dominantly slightly acid to neutral, though the sand just above the IIC3 horizon is calcareous in places.

RICHTER SERIES

The Richter soils have an upper sequum typical of Podzols and a lower sequum typical of Gray Wooded soils. These soils formed in stratified outwash deposits of loamy sand and sandy loam. They are chiefly on terraces and valley trains.

These soils are somewhat poorly drained. They are in the same catena as the poorly drained and very poorly drained Tonkey soils. The material in which they formed contains less silt and fine sand than that of the Brimley soils, and more silt and clay than that of the Wainola soils. The substratum of the Richter soils is less gravelly than that of the Gladwin soils.

Profile of Richter loamy sand:

Ap—0 to 6 inches, very dark brown (10YR 2/2) loamy sand; weak, medium, granular structure; very friable; neutral; abrupt, smooth boundary.
A2—6 to 9 inches, pale-brown (10YR 6/3) loamy sand; weak, thin, platy structure; very friable; neutral; abrupt, wavy boundary.
Bir—9 to 13 inches, strong-brown (7.5YR 5/6) sandy loam; common, coarse, distinct, yellowish-red (5YR 4/8) mottles; weak, medium, subangular blocky structure; friable; neutral; abrupt, wavy boundary.
B'tg—13 to 23 inches, dark reddish-gray (5YR 4/2) sandy clay loam; common, medium, distinct mottles of light brownish gray (10YR 6/2); moderate, fine, subangular blocky structure; firm; mildly alkaline.
C—23 to 42 inches +, yellowish-brown (10YR 5/4), stratified sandy loam and loamy sand; many, medium, distinct mottles of yellowish red (5YR 4/6) and grayish brown (10YR 5/2); massive; very friable; calcareous.

Undisturbed areas have a very dark gray (10YR 3/1) A1 horizon 1 to 3 inches thick. The Ap horizon ranges to very dark grayish brown (10YR 3/2) in color and from 6 to 10 inches in thickness. The Bir horizon ranges to dark brown (10YR 4/3) in color and from 5 to 10 inches in thickness. A grayish-brown (10YR 5/2) A'2 horizon 1 to 3 inches thick is between the Bir and B'tg horizons in some areas. The B'tg matrix ranges to grayish brown (10YR 5/2) in color. The B'tg horizon ranges from sandy clay loam to sandy loam or loam. Thin layers of sand are in the C horizon in a few areas.

RIFLE SERIES

The Rifle series consists of Bog soils derived from coniferous and deciduous woody and fibrous materials. These soils occur in level to depressional areas. The original vegetation was elm, ash, aspen, willow, tamarack, and cedar trees.

The Rifle soils are better decomposed and less acid than the Dawson and Greenwood soils and less well decomposed and more acid than the Carbondale soils. These soils formed in thicker organic deposits than the Adrian soils.

Profile of Rifle peat (NW¼NE¼ sec. 14, T. 20 N., R. 7 E.):

1—0 to 21 inches, dark grayish-brown (10YR 4/2) peat; weak, fine, granular structure; friable; contains woody and fibrous plant materials; very strongly acid; clear, smooth boundary.
2—21 to 36 inches, dark reddish-brown (5YR 3/4) peat that consists of reeds and sedges; fibrous; massive; very strongly acid; gradual, wavy boundary.
3—36 to 46 inches +, brown (7.5YR 5/3) peat; fibrous; massive; very strongly acid.

The first layer ranges to very dark grayish brown (10YR 3/2) in color. The material is very strongly acid to strongly acid. Mineral material is at a depth of 44 inches in a few areas.

ROSCOMMON SERIES

In the Roscommon series are Humic Gley soils formed in neutral to calcareous, medium and coarse sands. These soils are poorly drained and very poorly drained. They are in nearly level to depressional areas on outwash plains and glacial drainageways. Lowland forests of elm, ash, aspen, black spruce, and white-cedar made up the original vegetation.

These soils are closely associated with the Rubicon, Au Gres, and Saugatuck soils. They are similar to the Tobico soils, which also formed in sand, but those soils are calcareous at or near the surface. Roscommon soils differ from the Deford soils in having formed in coarser sand. They have a thinner A horizon than the Burleigh soils, which formed in 18 to 42 inches of sand or loamy sand over stratified very fine sand and silt. Their A1 horizon is thinner than that of the Epoufette soils and they lack the textural Bt horizon of those soils, which are underlain by calcareous, coarse sand and fine gravel at a depth of 18 to 42 inches. Roscommon soils have a much thinner A1 horizon than the Maumee soils.

Profile of Roscommon loamy sand (NE¼SW¼ sec. 31, T. 19 N., R. 6 E.):

A1—0 to 4 inches, black (10YR 2/1) loamy sand; weak, fine, granular structure; very friable; neutral; clear, wavy boundary.
C1—4 to 25 inches, dark grayish-brown (10YR 4/2) sand; common, medium, distinct mottles of light brownish gray (10YR 6/2) and light gray (10YR 7/1); single grain; loose; neutral; gradual, wavy boundary.
C2—25 to 45 inches, pale-brown (10YR 6/3) sand; common, coarse, distinct mottles of dark grayish brown (10YR 4/2) and dark brown (10YR 4/3); single grain; loose; neutral; abrupt, wavy boundary.
C3—45 inches +, grayish-brown (10YR 5/2) sand; common, coarse, distinct mottles of very pale brown (10YR 7/4); single grain; loose; calcareous.

Some areas have a cover of 2 to about 10 inches of muck or peat on the surface. In cultivated areas the plow layer, or Ap horizon, ranges from grayish brown (10YR 5/2) to dark grayish brown (10YR 4/2 in color. In some places the C1 horizon is light brownish gray (10YR 6/2) and has a few mottles. The solum ranges from slightly acid to mildly alkaline. In many areas the water table is at or near the surface for much of the year.

ROUSSEAU SERIES

In the Rousseau series are Podzols that formed in stratified fine sand and loamy fine sand. These soils are on outwash plains and moraines. The original forests included various kinds of trees, but maple and white pine were dominant.

These soils are well drained and moderately well drained. They are in the same catena as the somewhat poorly drained Wainola soils and the poorly drained and very poorly drained Deford. Rousseau soils are coarser textured than the Bohemian soils. They are similar to the Rubicon soils, but those soils formed in medium and coarse sand and lack the stratification of the Rousseau soils.

Profile of Rousseau loamy fine sand (SE¼SE¼NW¼ sec. 19, T. 20 N., R. 5 E.):

Ap—0 to 6 inches, brown (10YR 4/3) loamy fine sand; weak, medium and coarse, granular structure; very friable; medium acid; abrupt, smooth boundary.
A2—6 to 8 inches, pinkish-gray (7.5YR 6/2) fine sand; single grain; loose; medium acid; abrupt, wavy boundary.
B21ir—8 to 13 inches, brown (7.5YR 4/4) loamy fine sand; weak, fine, subangular blocky structure; very friable; slightly acid; clear, wavy boundary.
B22ir—13 to 22 inches, strong-brown (7.5YR 5/6) fine sand; weak, coarse, granular structure; very friable; slightly acid; clear, wavy boundary.
B3—22 to 32 inches, yellowish-brown (10YR 5/4) fine sand; single grain; loose; neutral; abrupt, smooth boundary.
C—32 to 63 inches +, pale-brown (10YR 6/3) fine sand; single grain; loose; neutral.

Undisturbed areas have a very dark grayish-brown (10YR 3/2) A1 horizon 1 to 3 inches thick. The A2

horizon ranges from 1 to 5 inches in thickness. The color of the B21ir horizon ranges to dark reddish brown (5YR 3/3), and that of the B22ir horizon ranges to brown (10YR 5/4). The solum ranges from strongly acid to slightly acid.

RUBICON SERIES

The Rubicon series consists of well-drained Podzols. These soils formed in medium and coarse sands on outwash plains, beach ridges, and moraines. The original vegetation was chiefly red pine and white pine but included some jack pine.

Rubicon soils are more acid than the Eastport soils. They formed in coarser sand than the Rousseau soils.

Profile of Rubicon sand [11] (SE¼ sec. 27, T. 18 N., R. 4 E.):

A1—0 to 2 inches, very dark gray (10YR 3/1) sand; weak, fine, granular structure; very friable; medium acid; abrupt, wavy boundary.

A2—2 to 6 inches, light brownish-gray (10YR 6/2) sand; weak, fine, granular structure; very friable; medium acid; clear, irregular boundary.

B21ir—6 to 9 inches, strong-brown (7.5YR 5/6) sand; very weak granular structure; very friable; contains a few weakly cemented chunks of sand; medium acid; gradual, wavy boundary.

B22ir—9 to 22 inches, yellowish-brown (10YR 5/6) sand; very weak, fine, granular structure; very friable; medium acid; gradual, wavy boundary.

C—22 to 60 inches +, light yellowish-brown (10YR 6/4) sand; single grain; loose; medium acid.

Cultivated areas have a very dark grayish-brown (10YR 3/2) Ap horizon 6 to 10 inches thick. The color of the B21ir horizon ranges to dark yellowish brown (10YR 4/4) or dark brown (7.5YR 4/4), and that of the B22ir horizon ranges to yellowish brown (10YR 5/4). The C horizon is faintly mottled below a depth of 42 inches in some areas. Loam to clay is below a depth of 42 inches in some areas. In places gravel is in the C horizon. The profile is slightly acid to strongly acid throughout.

RUDYARD SERIES

The Rudyard series consists of Gray Wooded soils formed in stratified lacustrine clay and silty clay. These soils are on lake plains. Mixed hardwoods made up the original vegetation.

These soils are somewhat poorly drained. They are in the same catena as the poorly drained Pickford soils and the very poorly drained Bergland. Rudyard soils formed in finer textured material than the Bowers soils.

Profile of Rudyard silty clay loam (SW¼SW¼ sec. 16, T. 20 N., R. 3 E.):

A1—0 to 4 inches, very dark grayish-brown (10YR 3/2) silty clay loam; moderate, medium, granular structure; firm; slightly acid; abrupt, smooth boundary.

A2—4 to 7 inches, light brownish-gray (10YR 6/2) silty clay loam; weak, medium, platy structure; firm; neutral; clear, irregular boundary.

Bg—7 to 20 inches, dark reddish-gray (5YR 4/2) silty clay; many, medium, coarse, faint, gray (10YR 5/1) mottles; tongues of light brownish-gray (10YR 6/2) material from A2 horizon extend into this horizon; moderate, medium, angular blocky structure; very firm when moist, sticky when wet; neutral; abrupt, wavy boundary.

C—20 to 42 inches +, brown (7.5YR 5/4) clay; many, medium, distinct mottles of light gray (N 7/0) and yellowish brown (10YR 5/6); massive; very firm when moist, very sticky when wet; calcareous.

Cultivated areas have a very dark grayish-brown (10YR 3/2) Ap horizon 6 to 9 inches thick. The A2 horizon is absent in some areas and occurs only as tongues or thick coatings on the faces of peds in the upper part of the Bg horizon. Texture of the Bg and C horizons ranges from clay to silty clay. Thin layers of silt loam and silty clay loam are in the Bg and C horizons in a few areas. Depth to the C horizon ranges from 18 to 30 inches.

SAGANING SERIES

The Saganing series consists of Humic Gley soils. These soils formed in fine sandy loam, sandy loam, or heavy loamy fine sand 15 to 36 inches thick over medium and coarse sand. Stands of lowland conifers made up the original vegetation.

These soils are coarser textured throughout the solum than the Lacota soils and finer textured than the Epoufette.

Profile of Saganing sandy loam (NW¼NW¼ sec. 31, T. 19 N., R. 6 E.):

Ap—0 to 8 inches, very dark gray (10YR 3/1) sandy loam; weak, medium, granular structure; very friable; mildly alkaline; abrupt, smooth boundary.

B21g—8 to 13 inches, light brownish-gray (10YR 6/2) sandy loam; weak, thin, platy structure; very friable; neutral; clear, wavy boundary.

B22g—13 to 24 inches, light-gray (10YR 7/2) sandy loam; a few, fine, distinct mottles of yellowish brown (10YR 5/6) and yellowish red (5YR 5/6); weak, medium, subangular blocky structure; friable; mildly alkaline; clear, wavy boundary.

IIC—24 inches +, light-gray (10YR 7/2) medium and coarse sand; common, medium, faint mottles of pale brown (10YR 6/3); single grain; loose; mildly alkaline.

A layer of muck 2 to 8 inches thick is on the surface in some undisturbed areas. The texture of the B horizon ranges from sandy loam to fine sandy loam. Depth to the IIC horizon ranges from 15 to about 36 inches. The solum is dominantly neutral to mildly alkaline.

SAUGATUCK SERIES

In the Saugatuck series are Ground-Water Podzols. These soils consist of acid sand. They are in level to depressional areas. The original vegetation was forests of aspen, cedar, and black spruce that had a ground cover of mosses and ferns. Saugatuck soils are similar to the Au Gres and Roscommon soils but have a cemented Bhir horizon, or ortstein.

Profile of Saugatuck loamy sand:

Ap—0 to 8 inches, very dark gray (10YR 3/1) loamy sand; weak, medium, granular structure; very friable; medium acid; abrupt, smooth boundary.

A2—8 to 14 inches, light-gray (10YR 7/1) sand; single grain; loose; strongly acid; abrupt, wavy boundary.

B21hirm—14 to 18 inches, dark reddish-brown (5YR 2/2) loamy sand; weak, very thick, platy structure; cemented; strongly acid; abrupt, wavy boundary.

B22—18 to 22 inches, dark-brown (7.5YR 4/4) sand; weak, thick, platy structure; firm when moist, slightly hard when dry; strongly acid; clear, wavy boundary.

B23ir—22 to 36 inches, strong-brown (7.5YR 5/6) sand; single grain; loose; medium acid; clear, wavy boundary.

C—36 to 48 inches, brown (10YR 5/3) sand; many, medium, distinct mottles of dark brown (10YR 4/3) and gray (10YR 5/1); single grain; loose; medium acid.

[11] Shown as Melita in material published by the Michigan Agricultural Experiment Station.

Undisturbed areas have a black (10YR 2/1) A1 horizon 1 to 5 inches thick. The A2 horizon ranges to light brownish gray (10YR 6/2) in color. The B21hirm horizon ranges to dark reddish brown (5YR 3/3-3/4) in color and from 3 to 10 inches in thickness. In color the B22 horizon ranges to reddish brown (5YR 4/4). The solum ranges from very strongly acid to medium acid. For part of the year, the water table is within a few inches of the surface.

SELKIRK SERIES

The Selkirk series consists of Gray Wooded soils formed in till of silty clay or clay. The native vegetation was chiefly forests of northern hardwoods but included some cedars and hemlocks.

These soils are somewhat poorly drained. They are in the same catena as the well drained and moderately well drained Kent soils and the poorly drained Pickford and Bergland soils. Selkirk soils are finer textured than the Kawkawlin soils.

Profile of Selkirk loam (NE¼NE¼ sec. 36, T. 19 N., R. 4 E.):

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) loam; moderate, medium, subangular blocky structure; friable; slightly acid; abrupt, irregular boundary.

A2g—9 to 11 inches, light brownish-gray (10YR 6/2) silt loam; weak, very thin, platy structure; friable; slightly acid; abrupt, irregular boundary.

B21—11 to 14 inches, reddish-brown (5YR 5/3) silty clay; many, coarse, distinct mottles of yellowish red (5YR 5/6); tongues of light brownish-gray (10YR 6/2) silt loam similar to that in the A2 horizon extend into this horizon; moderate, fine, angular blocky structure; firm when moist, plastic when wet; slightly acid; clear, wavy boundary.

B22—14 to 21 inches, reddish-brown (5YR 5/3) clay; strong, fine, angular blocky structure; very firm when moist, very plastic when wet; mildly alkaline; abrupt, wavy boundary.

C—21 to 42 inches +, brown (7.5YR 5/4) clay; strong, fine, angular blocky structure; very firm when moist, plastic when wet; calcareous.

Undisturbed areas have a very dark grayish-brown (10YR 3/2) A1 horizon 1 to 3 inches thick. The Ap horizon ranges to dark grayish brown (10YR 4/2) in color and from 6 to 10 inches in thickness. The A2 horizon ranges to grayish brown (10YR 5/2) in color and from 1 to 4 inches in thickness. The A2 horizon is lacking in some cultivated areas, especially where the thickness of the Ap horizon is more than 8 inches. Here the A2 horizon is in the B21 horizon as tongues, coatings on peds, and fillings in cracks. In color the matrix of the B horizon ranges to brown (7.5YR 5/4). The B22 horizon is mottled with pinkish gray (5YR 6/2) in some areas. The solum ranges from slightly acid to mildly alkaline. Thickness of the solum ranges from 14 to about 25 inches.

SIMS SERIES

In the Sims series are Humic Gley soils formed in till of calcareous clay loam or silty clay loam. These soils are on broad, nearly level areas on till plains and in depressions in moraines. The original vegetation was swamp hardwoods.

These soils are poorly drained and very poorly drained. They are in the same catena as the well drained and moderately well drained Nester soils and the somewhat poorly drained Kawkawlin. They are similar to the Hettinger soils in texture, but those soils formed in stratified lacustrine deposits and the texture of their B and C horizons is more variable. Sims soils have a coarser textured solum than the Bergland and Pickford soils and lack the C horizon of silty clay or clay typical of those soils. They are similar to the Wisner soils, which formed in like till but are calcareous at or near the surface.

Profile of Sims clay loam (NW¼NW¼ sec. 24, T. 18 N., R. 4 E.):

Ap—0 to 7 inches, black (10YR 2/1) clay loam; moderate, medium, granular structure; firm; mildly alkaline; abrupt, smooth boundary.

B21g—7 to 15 inches, light brownish-gray (10YR 6/2) clay loam; a few, medium, distinct mottles of brown (10YR 5/3) and yellowish brown (10YR 5/4); moderate, medium, angular blocky structure; firm; mildly alkaline; gradual, wavy boundary.

B22g—15 to 32 inches, light-gray (10YR 7/1) clay loam; many, coarse, distinct mottles of yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4); moderate, medium, angular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.

Cg—32 to 42 inches +, grayish-brown (10YR 5/2) clay loam; many, coarse, distinct mottles of yellowish brown (10YR 5/4) and brown (10YR 5/3); weak, coarse, angular blocky structure; firm.

A layer of muck or peat 1 to 12 inches thick is on the surface in some undisturbed areas. The A1 horizon is thicker than depth of plowing in some areas, and here a black (10YR 2/1) A'2 horizon is between the Ap and B21g horizons. The lower boundary of the A1 horizon generally is abrupt or clear. The Ap horizon ranges to very dark gray (10YR 3/1) in color and from 6 to 9 inches in thickness. The basic color of the B horizon ranges to brown (10YR 5/3). In some areas there is little mottling in the B21g horizon or mottling is lacking. The texture of the B horizon ranges from clay loam to silty clay loam or light clay. The solum ranges from 20 to 40 inches in thickness. It is slightly acid to mildly alkaline.

SUMMERVILLE SERIES

In the Summerville series are well-drained Brown Forest soils. These soils formed in sandy loam underlain by limestone bedrock at a depth of less than 18 inches. The native vegetation was balsam, fir, white-cedar, and yellow birch. These soils are underlain by limestone at a shallower depth than the Duel soils. The areas are small and most are in woodland or in pasture.

Profile of Summerville sandy loam (NW¼SW¼ sec. 13, T. 20 N., R. 7 E.):

A1—0 to 5 inches, very dark gray (10YR 3/1) sandy loam; weak, medium, granular structure; friable; medium acid; clear, smooth boundary.

A2—5 to 6 inches, pale-brown (10YR 6/3) sandy loam; weak, fine, granular structure; friable; neutral; clear, smooth boundary.

B—6 to 10 inches, brown (7.5YR 4/4) sandy loam; weak, medium, subangular blocky structure; friable; neutral; contains fragments of light-gray (10YR 6/1) limestone; abrupt, irregular boundary.

IIR—10 inches +, light-gray (10YR 6/1) limestone bedrock; calcareous.

The A1 horizon ranges to very dark brown (10YR 2/2). Depth to bedrock ranges from 8 to 18 inches. Fragments of limestone are scattered throughout the solum in some areas.

TAWAS SERIES

In the Tawas series are Bog soils derived from woody and fibrous organic materials that are 12 to 42 inches thick over sand or loamy sand. These soils consist of a mixture of material from deciduous and coniferous trees and of material derived from reeds, sedges, grasses, and other fibrous plants. The native vegetation was forests of swamp hardwoods mixed with white-cedar and black spruce. Most areas are now wooded.

These soils are similar to the Rifle and Carbondale soils, but those soils formed in organic material more than 42 inches thick. They are also similar to the Linwood, Willette, and Edwards soils, but Linwood soils are underlain by sandy loam to clay loam, Willette soils by heavy clay loam to clay, and Edwards soils by marl. All of these soils range from 12 to 42 inches in thickness. Tawas soils are less acid than the Adrian soils, which were derived from reeds, sedges, grasses, and other fibrous plants and contain little or no woody material.

Profile of Tawas muck (NE¼NE¼ sec. 7, T. 19 N., R. 6 E.):

1—0 to 12 inches, black (10YR 2/1) muck that contains many fragments of partly decomposed woody material; moderate, fine, granular structure; friable; slightly acid; gradual, wavy boundary.
2—12 to 30 inches, dark-brown (7.5YR 3/2) peaty muck; contains many pieces of partly decomposed wood of various sizes; weak, coarse, granular structure to weak, thick, platy; soft; slightly acid; abrupt, wavy boundary.
IIC—30 to 42 inches +, pale-brown (10YR 6/3) sand; many, coarse, distinct mottles of brown (10YR 5/3), strong brown (7.5YR 5/6), and yellowish brown (10YR 5/6); single grain; loose; calcareous.

The organic layers are peat in some areas, but the second horizon is muck in some areas. In other areas the organic material below a depth of 12 inches is peat. The quantity of partly decomposed wood fragments varies but is enough to be noticeable. The organic material ranges from medium acid to neutral. The lower 2 to 3 inches of the organic material contains much sand in some areas. Texture of the IIC horizon ranges from sand to loamy sand, to loamy fine sand, or to fine gravel.

TOBICO SERIES

The Tobico series consists of Humic Gley soils that formed in medium and coarse sand. These soils are in nearly level to depressional areas in outwash plains and lake plains. They are mostly along the shore of Saginaw Bay, just north of the mouth of Pine River and near the mouth of the Rifle River. The original vegetation was northern swamp hardwoods mixed with white-cedar and black spruce.

Tobico soils are similar to Roscommon soils, but unlike those soils, are calcareous at or near the surface. They lack the textural B horizon typical of the Epoufette soils, and they are darker colored, less acid, and more poorly drained than the Au Gres soils. Tobico soils are similar to the Brevort and Pinconning soils, but those soils have a more acid solum and are underlain by loam to silty clay loam and silty clay to clay, respectively, at a depth of less than 42 inches.

Profile of Tobico loamy fine sand (SW¼SW¼ sec. 36, T. 19 N., R. 5 E.):

O1—3 inches to 0, mat of peaty material.
A1—0 to 3 inches, black (10YR 2/1) loamy fine sand; very weak, fine, granular structure; very friable; calcareous; abrupt, wavy boundary.
C1—3 to 8 inches, grayish-brown (10YR 5/2) sand; single grain; loose; calcareous; gradual, wavy boundary.
C2—8 to 18 inches, light-gray (10YR 7/2) sand; single grain; loose; calcareous; gradual, wavy boundary.
C3—18 to 42 inches, very pale brown (10YR 7/3) sand; many, coarse, prominent, yellow (10YR 7/6–7/8) mottles; single grain; loose; calcareous; gradual, irregular boundary.

The A1 horizon ranges to very dark gray (10YR 3/1) in color and from 2 to 5 inches in thickness. A layer of muck or peat 3 to 10 inches thick is on the surface of some undisturbed areas. Cultivated areas have a dark grayish brown (10YR 4/2) Ap horizon 5 to 8 inches thick. The C1 horizon is gray (10YR 5/1) in some areas. In a few places the A and C1 horizons are mildly alkaline.

TONKEY SERIES

The Tonkey series consists of Humic Gley soils. These soils formed in stratified sand, loamy sand, and sandy loam that included some gravel and silt. They are in nearly level to depressional areas on broad outwash plains, lake plains, and deltas that are mostly in native trees or pasture. The original vegetation was swamp hardwoods, willows, swamp grasses, and sedges.

These soils are poorly drained and very poorly drained. They are in the same catena as the somewhat poorly drained Richter soils. Tonkey soils formed in coarser textured material than the Bruce soils and in finer textured material than the Deford. They are less gravelly than the Epoufette soils.

Profile of Tonkey sandy loam (NW¼NE¼ sec. 7, T. 20 N., R. 5 E.):

Ap—0 to 8 inches, black (10YR 2/1) sandy loam; weak, fine, granular structure; very friable; neutral; relatively high content of organic matter; abrupt, smooth boundary.
B21g—8 to 14 inches, grayish-brown (10YR 5/2) sandy loam; weak, fine, granular structure; very friable; neutral; clear, wavy boundary.
B22—14 to 28 inches, pale-brown (10YR 6/3) loam; common, medium, distinct mottles of strong brown (7.5YR 5/6) and brownish yellow (10YR 6/8); weak, medium, subangular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.
Cg—28 to 42 inches +, gray (10YR 5/1) stratified sand, sandy loam, and loamy sand that contains thin layers and lenses of gravel, silt, and loam; structure ranges from single grain to weak, coarse, subangular blocky, depending on the texture of the various layers; very friable to loose; calcareous.

A layer of muck 2 to 12 inches thick is on the surface in some undisturbed areas. The Ap horizon ranges from black (10YR 2/1) to very dark gray (10YR 3/1) in color and from 6 to 10 inches in thickness. The B21g horizon is mottled with strong brown (7.5YR 5/6) in some areas. The B21g and B22 horizons range from sandy loam to loam in texture or are stratified sandy loam, loamy sand, and loam. In texture the Cg horizon is dominantly sandy loam or loamy sand. The solum ranges from slightly acid to mildly alkaline.

TWINING SERIES

Soils of the Twining series have an upper sequum typical of Podzols and a lower sequum typical of Gray Wooded soils. These soils formed in glacial till of calcareous sandy clay loam or coarse clay loam. They

are on nearly level to gently sloping till plains. Forests of northern hardwoods made up the original vegetation.

Twining soils are somewhat poorly drained. They are in the same catena as the well drained and moderately well drained Isabella soils and the poorly drained and very poorly drained Sims soils. They contain more sand and less silt and clay than the Kawkawlin soils, which lack a Podzol upper sequum. The Twining soils are similar to the Bowers, but those soils formed in stratified lacustrine deposits and the till the Twining soils formed in is relatively nonstratified.

Profile of Twining sandy loam (SE¼NE¼ sec. 36, T. 18 N., R. 4 E.):

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

Bir—7 to 13 inches, yellowish-brown (10YR 5/6) sandy loam; weak, fine, subangular blocky structure; very friable; medium acid; clear, wavy boundary.

A'2—13 to 16 inches, pale-brown (10YR 6/3) sandy loam; common, medium, distinct mottles of dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6); weak, medium, platy structure; friable; slightly acid; clear, irregular boundary.

A'2m & B't—16 to 20 inches, reddish-brown (5YR 4/4) light sandy clay loam representing the B't horizon and pale-brown (10YR 6/3) sandy loam representing the A'2m horizon; weak, medium, subangular blocky structure; firm and brittle fragipan; slightly acid; clear, wavy boundary.

B'22t—20 to 30 inches, brown (7.5YR 5/4) clay loam; common, medium, distinct mottles of dark brown (7.5YR 4/4) and light brownish gray (10YR 6/2); moderate, medium, subangular blocky structure; firm; slightly acid.

C—30 inches +, light-brown (7.5YR 6/4) clay loam; many, medium, distinct mottles of light brownish gray (10YR 6/2); weak, coarse, angular blocky structure; firm; calcareous.

Undisturbed areas have an A1 horizon that is very dark grayish brown (10YR 3/2) and is 1 to 3 inches thick. A light brownish-gray (10YR 6/2) A/2 horizon is above the Bir horizon in undisturbed areas and in places in cultivated areas. The Bir horizon ranges to dark brown (7.5YR 4/4) in color and from 4 to 8 inches in thickness. The color of the A'2 horizon ranges to grayish brown (10YR 5/2). Degree of development of the fragipan in the A'2m & B't horizon ranges from weak to moderate, and its consistence ranges from firm and brittle to slightly firm. The basic color of the B't part of the A'2 & B't horizon is brown (7.5YR 5/2) in some areas. The matrix of the B'22t horizon ranges to brown (7.5YR 5/2) in color and from clay loam to sandy clay loam. In texture the C horizon ranges from clay loam to sandy clay loam. The solum ranges from 25 to about 40 inches in thickness and from slightly acid to medium acid.

UBLY SERIES

In the Ubly series are soils that have an upper sequum typical of Podzols and a lower sequum typical of Gray Wooded soils. These soils formed in loamy fine sand to fine sandy loam 18 to 42 inches thick over loam to silty clay loam. They occur with the Isabella soils on till plains and moraines in the northern part of the county. Northern hardwoods and white pines made up the original vegetation.

These soils are well drained and moderately well drained. They are in the same catena as the somewhat poorly drained Belding soils. Ubly soils are loamy fine sand to fine sandy loam to a greater depth than the Isabella soils. Their solum is finer textured than that of the Menominee soils.

Profile of Ubly fine sandy loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

Bir—8 to 15 inches, dark-brown (10YR 4/3) sandy loam; weak, medium, granular structure; friable; medium acid; clear, wavy boundary.

A'2—15 to 20 inches, pale-brown (10YR 6/3) sandy loam; weak, medium, platy structure; friable; medium acid; clear, irregular boundary.

B't—20 to 32 inches, dark-brown (7.5YR 4/4) heavy clay loam; the upper part of this horizon contains tongues and coatings of pale brown (10YR 6/3) from the horizon above; moderate, medium, angular blocky structure; firm; neutral; abrupt, wavy boundary.

C—32 to 42 inches +, brown (7.5YR 4/4) clay loam; weak, medium, angular blocky structure; firm; calcareous.

Undisturbed areas have a very dark grayish-brown (10YR 3/2) A1 horizon, 1 to 3 inches thick, and a light brownish-gray (10YR 6/2) A2 horizon, 1 to 6 inches thick, above the Bir horizon. In some cultivated areas an A2 horizon from 1 to 4 inches in thickness is above the Bir horizon. In color the Bir horizon ranges to dark brown (7.5YR 4/4) or dark yellowish brown (10YR 4/4). The A'2 horizon occurs as tongues and thick coatings on peds in the upper part of the B't horizon in some areas. The B't horizon ranges to dark yellowish brown (10YR 4/4) or reddish brown (5YR 5/4) in color and from 6 to 16 inches in thickness. The Podzol sequum and the A'2 horizon range from medium acid to slightly acid. The B't horizon ranges from slightly acid to neutral. Texture of the C horizon ranges from clay loam to silty clay loam or heavy loam.

WAINOLA SERIES

The Wainola series consists of Podzols. These soils formed in stratified fine sand and loamy fine sand. They are on outwash plains and in narrow drainageways. The original vegetation was chiefly a mixture of upland and lowland hardwoods but included some cedar.

These soils are somewhat poorly drained. They are in the same catena as the well-drained Rousseau soils and the poorly drained and very poorly drained Deford. They are similar to the Au Gres, but those soils formed in medium and coarse sands. Wainola soils have a coarser textured profile than the Brimley soils.

Profile of Wainola loamy fine sand (SE¼SW¼ sec. 12, T. 20 N., R. 6 E.):

A1—0 to 2 inches, black (10YR 2/1 loamy fine sand; weak, fine, granular structure; very friable; medium acid; abrupt, smooth boundary.

A2—2 to 10 inches, pinkish-gray (7.5YR 6/2) loamy fine sand; very weak, thin, platy structure; very friable; strongly acid; abrupt, wavy boundary.

B21ir—10 to 14 inches, brown (7.5YR 5/4 loamy fine sand; common, medium, faint mottles of light brown (7.5YR 6/4) and dark brown (7.5YR 4/4); very weak, coarse, subangular blocky structure; very friable; strongly acid; gradual, wavy boundary.

B22ir—14 to 25 inches, yellowish-brown (10YR 5/4) very fine sand; common, medium, faint mottles of pale brown (10YR 6/3) and reddish yellow (7.5YR 6/6); very weak, coarse, subangular blocky structure; very friable; medium acid; gradual, wavy boundary.

B3—25 to 32 inches, dark yellowish-brown (10YR 4/4) fine sand; common, medium, distinct mottles of strong brown (7.5YR 5/6), reddish yellow (7.5YR 6/6), and light brown (7.5YR 6/4); single grain; loose; medium acid; gradual, wavy boundary.
C—32 inches +, very pale brown (10YR 7/3) fine sand or loamy fine sand; single grain; loose; slightly acid.

The A1 horizon ranges to very dark gray (10YR 3/1) in color and from 1 to 4 inches in thickness. Cultivated areas have a very dark grayish-brown (10YR 3/2) Ap horizon 6 to 10 inches thick. In color the B21ir horizon ranges to dark yellowish brown (10YR 4/4). In places a few chunks of ortstein are in the B21ir horizon. Mottling is lacking in the B21ir horizon in some areas. Depth to mottling ranges from 6 to about 20 inches, and the mottles range from few to many in abundance. Reaction of the solum ranges from medium acid to strongly acid, and that of the C horizon from slightly acid to neutral. Calcareous material is at a depth below 42 inches in some areas.

WARNERS SERIES

The Warners series consists of Bog soils. These soils are made up of organic material or are a mixture of organic and mineral materials. They are underlain by marl of varying purity at a depth of 12 inches or less. These soils are in nearly level to depressional areas. The original vegetation was elm, soft maple, willow, and sedges.

Warners soils are underlain by marl at a shallower depth than the Edwards soils and contain more mineral material. They are similar to the Markey soils, but those soils lack the marl typical of the Warners soils.

Profile of Warners muck (NE. corner of sec. 22, T. 20 N., R. 6 E.):

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) muck; weak, medium, granular structure; friable; calcareous; abrupt, smooth boundary.
IIC—8 to 20 inches +, light-gray (5Y 6/1) marl; contains numerous animal shells; friable; calcareous; abrupt, smooth boundary.

The surface layer is marl or is a mixture of marl and loam in some areas. The muck in the surface layer ranges from 4 to 12 inches in thickness. Below a depth of 15 inches the IIC horizon contains thin layers of mineral material that range from sand to silty clay loam in some areas.

WILLETTE SERIES

The Willette series consists of Bog soils. These soils formed in plant remains derived from deciduous or coniferous trees and from fibrous reeds, sedges, and grasses. The organic material is underlain by heavy clay loam to clay at a depth of 12 to 42 inches. These soils are in nearly level to depressional areas on outwash plains, till plains, and moraines. The original vegetation was chiefly mixed hardwoods but included some conifers. Trees common on the areas were elm, ash, and soft maple.

Willette soils are similar to Rifle and Carbondale soils, but those soils formed in organic material more than 42 inches thick. They are also similar to the Linwood, Tawas, Adrian, and Edwards soils, but Linwood soils are underlain by sandy loam to clay loam, Tawas and Adrian by sand, and Edwards by marl, all at a depth of 12 to 42 inches.

Profile of Willette muck (NE¼NE¼ sec. 15, T. 20 N., R. 7 E.):

1—0 to 8 inches, very dark brown (10YR 2/2) muck that contains numerous wood fragments; moderate, fine, granular structure; friable; slightly acid; gradual, smooth boundary.
2—8 to 15 inches, very dark brown (10YR 2/2) muck that contains many partly decomposed wood fragments; weak coarse, granular structure; friable; slightly acid; gradual, wavy boundary.
3—15 to 30 inches, dark-brown (7.5YR 4/2) peat that is made up of a mixture of woody and fibrous material; weak, thick, platy structure; friable; slightly acid; abrupt, wavy boundary.
IIC—30 to 42 inches +, light-gray (2.5Y 7/2) clay; massive; firm; calcareous.

In color the first horizon ranges to black (10YR 2/1). The third horizon is muck or peaty muck in some areas. The lower 2 to 3 inches of the organic material contains considerable mineral material in some areas. Texture of the IIC horizon ranges from heavy clay loam to heavy silty clay loam, silty clay, or clay. The organic material ranges from medium acid to neutral.

WISNER SERIES

In the Wisner series are Humic Gley soils formed in till consisting of clay loam or silty clay loam. These soils are in level to depressional areas, mostly below the lowest beach ridges and only a few feet above the level of Lake Huron. Lowland forests and reeds and sedges made up the original vegetation.

Wisner soils are similar to the Sims soils but differ from those soils in being calcareous at or near the surface. They are coarser textured than the Charity soils.

Profile of Wisner clay loam (NW¼NW¼ sec. 16, T. 18 N., R. 5 E.):

Ap—0 to 8 inches, black (10YR 2/1) clay loam; moderate, coarse, granular structure; firm; calcareous; abrupt, smooth boundary.
Bg—8 to 18 inches, gray (10YR 5/1) clay loam; common, medium, distinct mottles of brown (7.5YR 5/4 and 4/4); moderate, medium, angular blocky structure; firm; calcareous; gradual, wavy boundary.
Cg—18 to 42 inches +, grayish-brown (10YR 5/2) clay loam; many, coarse, distinct mottles of pale brown (10YR 6/3) and yellowish brown (10YR 5/6); weak, coarse, angular blocky structure; firm; calcareous.

A thin layer of muck 1 to 10 inches thick is on the surface in some undisturbed areas. In some areas thickness of the A1 horizon is greater than depth of plowing. The matrix of the Bg horizon ranges to dark gray (10YR 4/1) or grayish brown (10YR 5/2). Thin strata of loam and sandy loam are in the Cg horizon in some areas. The surface layer is generally calcareous. It is free of carbonates in the upper few inches in some areas, though it is moderately alkaline in reaction.

General Nature of the County

In this section the history and development, geology, climate, vegetation, and water supply are discussed. Also discussed are the more outstanding features of the agriculture. The statistics given are from reports published by the U.S. Bureau of the Census.

History and Development

Before settlement in 1830 Arenac County was part of the land under control of the Chippewa and Ojibway

Indians. The area was first laid out as a county the next year, but in 1857 it was incorporated with Bay County, then newly formed. The area was reestablished as a separate county in 1883. The name Arenac, meaning sandy place, was coined from the Roman word arenas, which had surfaces of hard-packed sand.

By the latter part of the 19th century, most of the timber of good quality in the county had been cut, and the areas were being farmed. The population of the county was 9,640 by 1900, and it has increased but little since then, or to 9,860 in 1960.

Farming is the chief occupation. Some producing oil wells are in the county, but the production of these is decreasing. Commercial fishing is no longer productive because of the lamprey eel, which killed the trout once plentiful in Lake Huron. Many people who live in the county work in industrial plants outside the county.

The resort industry is growing steadily, and an increasing number of tourists visit the county each year. Camping, fishing, boating, swimming, and hunting provide recreation for tourists and business opportunities for residents of the county. The chief attractions for tourists are along Lake Huron.

Several highways crisscross the county. U.S. Highway No. 23 extends across the east side of the county, roughly parallel to the shoreline of Lake Huron. In no place is this highway more than 6 miles from the lake. From Standish, State Highway 76 runs in an angle to the northwest corner of the county, through Alger, and toward West Branch. Other main State and county highways traverse the county. In addition paved roads connect most of the principal villages with the main highways.

The New York Central Railroad enters the southern boundary of the county about 3 miles inland from Lake Huron. It runs due north to Standish, then turns northwestward through Sterling and Alger, and leaves the county near its northwest corner. The Detroit and Mackinac Railroad also enters the county along the southern boundary, but less than a mile from Lake Huron. It runs in a northeastern direction through the villages of Saganing, Omer, Twining, and Turner and into Iosco County to the north. These railroads move grain crops to market. Much of the other crops harvested is moved by trucks, however, to markets in the larger cities to the south.

Geology

Most of Arenac County is an old lakebed. Small areas consist of ground moraines and waterlaid moraines. In the lakebed areas, the material ranges from clay to clay loam, loam, or sand in texture. In many places this fine-textured material has been covered by sand that ranges from 6 inches to many feet in thickness. Deep deposits of sandy material occur throughout the lakebed, but they are predominant in the northwestern part of the county. Elevation of the lakebed ranges from slightly less than 600 feet to 750 feet above sea level.

Waterlaid moraines occupy four areas. One is in the eastern part of Whitney Township, the second is north and east of the village of Turner, the third is north of the Rifle River in Clayton Township and east of the Rifle River in Moffatt Township. The fourth waterlaid moraine is in the northwest corner of Moffatt Township. The ground moraines are in northern Clayton Township, northeastern Mason Township, northern Whitney Township, and west and south of the village of Sterling. Three small ground moraines are southwest of Sterling. Elevation of the waterlaid moraines ranges from less than 700 feet above sea level to approximately 850 feet, depending upon their location in the county.

The soil material in the moraines varies greatly. It ranges from clay to very coarse sand in texture.

Climate [12]

Arenac County has a modified continental climate. Because the county is adjacent to Lake Huron, the abrupt variations in temperature typical of the continental climate are reduced, particularly if the winds are from the east. Also this county is in the Lower Peninsula of Michigan, and the climate is further modified by winds from the west. These westerly winds cross Lake Michigan and pick up warmth and moisture in winter and cool, moist air in summer. As a result, throughout the Lower Peninsula, winter is milder and summer is cooler than at the same latitude in Wisconsin and Minnesota.

In spring the lake water cools the warm air that reaches the county. Growth of plants is therefore delayed until frost is no longer likely. In fall the lake water is warmed by the summer sun and thus warms the cold air moving into the area and holds back the first frost. Plants therefore have time to mature. This moderating effect is most noticeable in a strip a few miles wide along the lake and diminishes with increasing distance from the lake. For example, records at the Standish Weather Station show that the average growing season is 127 days, and it is estimated that in a strip 2 or 3 miles wide along the lake the growing season is about 135 days. In the extreme northwest corner of the county, however, the growing season, based on data from West Branch in Ogemaw County, is only about 115 days.

Annual temperature and precipitation, compiled from records of the U.S. Weather Station near Standish, are shown in table 9. In addition to the average monthly temperature and precipitation, the probabilities of very high and very low temperatures, and the amounts of precipitation, are shown. Temperature varies widely in the county. For example, in August 2 years in 10 will have at least 4 days when the temperature is 91° F. or higher. Also the temperature is 90° or more on an average of 6 days each summer. In February, on the other hand, the temperature is 6° below zero or colder for at least 4 days on an average of 2 years in 10. The temperature is zero or lower on an average of 13 days in winter. The 4 or more days may or may not occur consecutively.

The highest temperature ever recorded in the county was 103°, and the lowest was 40° below zero. A spread of 115° between the hottest and coldest temperatures recorded during a single year is not uncommon.

In table 10 the probabilities of last freezing temperatures in spring and first freezing temperatures in fall are shown. These figures are also from the U.S. Weather Station near Standish. They show that in 1 year in 10,

[12] By A. EICHMEIER, State climatologist, Weather Bureau, U.S. Department of Commerce.

TABLE 9.—*Temperature and precipitation near Standish, Arenac County, Mich.*[1]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average monthly total	One year in 10 will have—		Days with snow cover	Average depth of snow on days with snow cover of 1 inch or more
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—		
	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Number	Inches
January	30. 6	14. 1	42	5	2. 47	0. 5	2. 6	25	4. 7
February	31. 3	13. 2	42	−6	1. 44	. 6	2. 6	25	6. 7
March	40. 0	21. 4	52	14	1. 84	1. 0	2. 6	15	6. 8
April	56. 3	33. 9	74	27	2. 38	1. 9	3. 8	1	1. 0
May	61. 1	42. 3	82	34	2. 98	. 6	4. 5	0	0
June	78. 2	54. 2	89	44	3. 05	1. 6	4. 5	0	0
July	82. 9	57. 3	90	50	2. 90	1. 0	6. 8	0	0
August	81. 1	56. 2	91	50	2. 61	. 4	5. 2	0	0
September	67. 2	47. 3	86	38	3. 03	. 6	5. 1	0	0
October	62. 2	37. 6	78	30	1. 75	. 5	4. 9	0	0
November	46. 9	29. 9	62	21	2. 47	1. 5	3. 2	2	2. 6
December	33. 5	19. 1	48	12	2. 12	. 6	2. 9	14	2. 3
Year	55. 9	35. 5			29. 04			82	2. 1

[1] Based on a 12-year record through 1961.

TABLE 10.—*Probabilities of last freezing temperatures in spring and first freezing temperatures in fall near Standish, Arenac County, Mich.*[1]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than	April 7	April 20	May 7	May 15	May 30
2 years in 10 later than	April 2	April 15	May 2	May 10	May 25
5 years in 10 later than	March 23	April 5	April 22	April 30	May 15
Fall:					
1 year in 10 earlier than	November 9	October 25	October 9	September 28	September 7
2 years in 10 earlier than	November 14	October 30	October 14	October 3	September 12
5 years in 10 earlier than	November 15	November 10	October 25	October 14	September 23

[1] Based on a 12-year record through 1961.

temperatures as low as 32° occur as late as May 30 in spring and as early as September 7 in fall. The chance that such cool days will occur late in spring and early in fall in the same year is low. Much corn is therefore grown for grain in the county, though the length of the growing season and the relatively cool temperatures in summer are near the minimum for such a crop. Varieties of corn that mature in 110 to 120 days can be grown near the lake with little risk of damage from frost, but varieties that mature in 100 days are best for planting in the western parts of the county. Because cold air is heavier than warm air it drains into low areas, and the frost-free season in such places is shorter than on adjacent higher areas.

Precipitation during the growing season is sufficient for a wide variety of crops. In the 6-month period from April through September, the rainfall averages about 17 inches and is well distributed. As shown in table 10, at Standish an average of only 1 year in 10 has less than 1.6 inches of rain in June, 1.0 inch in July, and 0.4 inch in August. The rates of evaporation and transpiration are relatively low because the air is cool, the humidity is high, and many days are cloudy or partly cloudy. Consequently the level of moisture in the soil is generally adequate for crops grown on all soils but the very sandy ones.

After the snow melts in spring, most soils are near saturation. Subsequent rainfall often delays planting of crops, particularly in areas that are poorly drained or somewhat poorly drained and that have inadequate artificial drainage. Late in spring and early in summer, rainfall on sloping cultivated soils that are saturated

causes severe erosion unless the surface of the soil is protected from runoff. Also damaging are rains of high intensity, which generally come in summer. These rains generally are less intensive than rains in the southern part of the Lower Peninsula and in States to the south and west, and they therefore cause less runoff and erosion. On an average, in Arenac County a rain of the intensity of 0.9 inch per hour occurs once every year, rain of the intensity of 1.6 inches per hour occurs 1 year in 10, and a rain of 1.9 inches per hour occurs 1 year in 25. In 1 year in 10 the county receives an average of 3.3 inches of rain in a period of 24 hours.

In fall moisture generally is favorable for preparation of seedbeds and germination of seeds. Cool weather and the relatively high soil moisture during the bloom stage promote good yields of oats. The cool, moist growing season favors hay and pasture, yields of which are commonly good if the soils are not too sandy and are well fertilized. Several days a year the wind is strong enough to cause erosion on mucky and sandy soils that are left unprotected.

Snowfall in the county averages 42.8 inches a year, and the ground is covered with snow an average of 82 days a year. In most winters enough snow falls to protect fields of winter grain. On the average measurable amounts of snow are present for 6 months each year.

Vegetation

Dense forests originally covered most of Arenac County. The only areas that were not forested were swamps, lake beaches, sand dunes near Lake Huron, and small areas cleared by the Indians for their villages and gardens.

On the sandy plains of the county, in well-drained areas, were forests consisting of white pine, red pine, and jack pine. On the finer textured, well-drained soils, sugar maple, beech, yellow birch, elm, and hemlock grew. Elm, ash, basswood, red maple, aspen, yellow birch, white pine, hemlock, black spruce, white-cedar, and balsam fir were dominant on the somewhat poorly drained mineral soils. In the peat and muck swamps, the native trees were mostly white-cedar, black spruce, balsam fir, and tamarack; reeds, sedges, and shrubs grew in openings in the swamps.

About 45 percent of the county is now wooded, but the stands are mostly second-growth trees of poor quality. Aspen, scrub oak, and jack pine are the trees on the sandy plains where the virgin timber was mostly pines. In the other forests the present stands consist chiefly of the original trees but the proportion of aspen in the stands is greater. Nearly 30,000 acres are in woodland on farms, and products from these wooded areas provide some cash income for the farmers. Most of the remaining woodland is owned by the State of Michigan. About 20,000 acres in the county has been planted to pines. Much idle land in the county is reforesting naturally.

Water Supply

Arenac County has a good supply of fresh water from several sources. Water from dug wells, or from sand points driven into the soil, provide ample water for many farms in the county. The ground water table is relatively high in much of the county and is an easily accessible source of water. Drilled wells, generally less than 200 feet deep, also are common in the county and provide a good supply of water.

Streams in the county flow throughout the year, and many of them are fed by springs. These streams therefore supply ample water to the pastures through which they flow. The fresh, clear water of Lake Huron provides an ample supply of water for industrial use, but at present little water from this lake is used in Arenac County.

Agriculture

Following extensive logging operations in the last two decades of the 19th century, much of the land in Arenac County was farmed. In 1900 there were 1,186 farms in the county, and their average size was about 67 acres. The number of farms, and their size, increased until 1920, when there were 1,392 farms that averaged about 97 acres each. Many farms, chiefly those on droughty or wet soils, have been abandoned since 1939. In 1959 there were 779 farms in the county, and their average size was nearly 140 acres.

The total land in farms in 1959 was 108,956 acres. Of this slightly more than 44 percent was in crops, nearly 29 percent was mostly in permanent pasture, and the rest was wooded. In 1959 about 37 percent of the income from farm products came from the sale of dairy products, more than 33 percent was from the sale of field crops, and about 25 percent was from livestock and livestock products other than dairy. Sales of miscellaneous products accounted for the rest.

The proportion of farms operated by owners has gradually decreased from 1900 when most farms were operated by owners. In 1960 about 70 percent of the farms were operated by owners. Of the rest nearly 26 percent were operated by part owners, more than 4 percent were worked by tenants, and two of the farms were operated by managers.

Crops.—Hay, corn, and oats are the chief crops grown in the county, but small grains, field beans, sugarbeets, potatoes, and garden vegetables are grown on some farms. The following gives the acreage of the main crops grown in 1959:

Crop:	Acres
All hay	17,147
Corn for all purposes	10,294
Small grains harvested:	
Oats	7,512
Wheat	5,573
Field beans	3,754
Sugarbeets	1,119

Yields of the chief crops grown in the county have increased in the last 30 years. This increase has come partly through the use of improved varieties of seed and partly because of better management.

The acreage in hay crops has decreased considerably, but the proportion of alfalfa hay has increased. Alfalfa hay accounted for 78 percent of the acreage in hay in 1959. The rest of the acreage was chiefly in clover, timothy, and mixtures of clover and grasses, but some wild hay was cut.

Corn is the chief row crop grown. Use of hybrids adapted to the soils and climate of the county has helped

to bring increased yields. Most of the corn was grown for grain, but more than a third of the acreage was grown for silage.

The acreage in wheat has fluctuated. It increased abruptly between 1939 and 1949 but has decreased since. The acreage in rye and barley has decreased greatly since 1929, and these crops are no longer important in the county. Soybeans were grown on a few farms, and most of the crop was harvested for beans.

In 1959 potatoes were grown on 917 acres and garden vegetables were grown on 437 acres.

Livestock.—The number of livestock and poultry in the county has fluctuated throughout the years. Dairy cattle are the chief livestock in the county, though the number of milk cows has decreased somewhat. In 1959 there were 5,348 milk cows in the county. On the other hand beef cattle have increased the past few years. This trend is likely to continue because much cleared land no longer used for cultivated crops is being developed for grazing. Hogs and pigs numbered 2,624 in 1959, and their number has been fairly constant in the county for 60 years. Sheep have decreased from a high of 5,536 in 1929 to 1,325 in 1959. The number of poultry has decreased from 52,279 in 1949 to 39,069 in 1959.

Glossary

Acidity. See Reaction.

Aggregate, soil. Many fine soil particles held in a single mass or cluster. See Structure, soil.

Alkalinity. See Reaction.

Alluvium. Soil or rock material, such as gravel, sand, silt, or clay deposited by a stream.

Available soil moisture. The moisture held by the soil in a form that can be used by plants.

Calcareous. Containing enough calcium carbonate to effervesce (fizz) when treated with dilute hydrochloric acid.

Catena. A group of soils developed from similar parent materials but differing in natural drainage or relief, or both.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Coarse-textured soils. Sand and loamy sand.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Some of the terms commonly used to describe consistence are—

Loose. Noncoherent; will not hold together in a mass.

Friable. When moist, crushes easily under gentle to moderate pressure between thumb and forefinger and can be pressed together into a lump.

Firm. When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic. When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a wire when rolled between thumb and forefinger.

Sticky. When wet, adheres to other material; tends to stretch somewhat and pull apart, rather than pull free from other material.

Hard. When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Compact. A combination of firm consistence and close packing or arrangement of soil particles.

Soft. When dry, breaks into powder or individual grains under very slight pressure.

Cradle knoll. A mound or ridge of earth on a forest floor often no more than 1 or 2 feet high; probably caused by the overthrow of large trees and consequent accumulation of the soil in the root mat through rainfall, frost action, and decay of the wood.

Depressional area. A low-lying area that lacks surface outlets for removal of water or has only poorly developed ones.

Drainage, artificial. The removal of excess water on or within the soil by means of surface or tile drains.

Drainage, natural. Refers to the conditions that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time; the water table is within 12 to 24 inches of the surface during part of the year; and in podzolic soils mottlings are below 6 to 16 inches in the lower A horizon and in the B and C horizons. Synonymous with *imperfectly drained*, the term that has been used in Michigan.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Fine-textured soil. Sandy clay, silty clay, and clay.

Green manure. Any crop grown for the purpose of being turned under in an early stage of maturity or soon after maturity for soil improvement.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes.

Humus. The dark colored, finely divided, well-decomposed, more or less stable part of the organic matter in mineral soils.

Imperfectly drained. See *Somewhat poorly drained* under Drainage, natural.

Lacustrine deposit. Material deposited in lake water and exposed by lowering of the water level or elevation of the land.

Leaching. The removal of material in solution by water passing through the soil.

Limy. See Calcareous.

Medium-textured soil. Soil of very fine sandy loam, loam, silt loam, or silt texture.

Mineral soil. Soil composed mainly of inorganic (mineral) material and low in content of organic material.

Moraine. An accumulation of earth, stones, and other debris deposited by a glacier. In this county there are ground moraines and water-laid moraines.

Morphology, soil. The makeup of the soil, including the texture, structure, consistence, color, and other physical, chemical, mineralogical, and biological properties of the various horizons in the soil profile.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils generally indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* contrast—*faint, distinct,* and *prominent.*

Muck. Well-decomposed, organic soil material developed from peat. Generally muck has a higher mineral or ash content than peat and the original plant parts cannot be identified. See also Peat.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 3/2 is a color with a hue of 10YR, a value of 3, and a chroma of 2 (*6*).

Neutral, soil. In practice, a soil that has a pH value between 6.6 and 7.3. Strictly speaking, a soil that has a pH value of 7.0.

Ortstein. An irregularly cemented, generally sandy, dark-yellow to nearly black horizon; a characteristic of some Podzols.

Parent material (soil). The relatively unaltered geological deposits similar to those from which at least a part of the soil profile has formed.

Peat. Unconsolidated soil material, largely undecomposed organic matter, that has accumulated where there has been excess moisture. See also Muck.

Ped. An individual natural soil aggregate, such as a crumb, prism, or block, in contrast to a clod, which is a mass of soil brought about by disturbance.

Permeable. Easily penetrated, as by water, roots, and air.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. The profile depth is arbitrarily set at 5 feet for most of the soils of Arenac County. See Horizon, soil.

Reaction. The degree of acidity or alkalinity of a soil, expressed in words and in pH values, as follows:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Relief. Elevations and inequalities of the land surface, considered collectively. Relief in this report refers to a particular area rather than separate slope.

Sand. Individual fragments of rocks or minerals that range from 0.05 millimeter (0.002 inch) to 2.0 millimeters (0.078 inch) in diameter. Most sand grains consist of quartz, but they may be of any mineral composition. The term also is applied to a soil that contains 85 percent or more sand and not more than 10 percent of clay.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. Two sequa may be present in a single soil and may be called a bisequum.

Silt. Individual mineral particles of soil that range from 0.002 millimeters (0.02 inch) in diameter. The term silt is also applied to a soil that contains 80 percent or more of silt and less than 12 percent of clay.

Slope. The inclination of the land surface from the horizontal; percentage of slope is the vertical distance, divided by horizontal distance, times 100. Thus a slope of 10 percent is a drop of 10 feet in 100 feet of horizontal distance.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting upon parent material, as conditioned by relief over periods of time.

Solum, soil. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separate from adjoining aggregates and have properties unlike those of unaggregated primary soil particles. Structure is described by grade (*weak, moderate,* or *strong*), that is, the distinctness and durability of the aggregates; by the size of the aggregates (*very fine, fine, medium, coarse,* or *very coarse*); and by their shape (*platy, prismatic, columnar, blocky, granular,* or *crumb*). A soil is described as structureless if there are no observable aggregates. Structureless soils may be *massive* (coherent) or *single grain* (noncoherent).

Blocky, angular. Aggregates are block shaped; they may have flat or rounded surfaces that join at sharp angles.

Blocky, subangular. Aggregates have some rounded and some plane surfaces; vertices are rounded.

Columnar. Aggregates are prismatic and are rounded at the upper ends.

Crumb. Generally soft, small, porous aggregates, irregular, but tending toward a spherical shape, as in many soils in the A1 horizon.

Granular. Roughly spherical, firm small aggregates that may be either hard or soft but that are generally firmer than crumb and lack the distinct faces of blocky structure.

Platy. Soil particles are arranged around a plane that is generally horizontal.

Prismatic. Soil particles are arranged around a vertical line; aggregates have flat, vertical surfaces.

Subsoil. Technically the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer lying beneath the solum, or true soil; the C horizon.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil.

Terrace, stream. An area that is fairly level and formerly was the flood plain of a stream but now lies above the present flood plain; the area is generally underlain by stratified stream sediments.

Texture, soil. The relative proportion of sand, silt, and clay particles in a soil. The basic textural classes in order of increasing proportions of fine particles are sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Weathering. The physical and chemical disintegration and decomposition of rocks and minerals. Soil is the result of weathering and other chemical, physical, and biological alterations that have changed the upper part of the earth's crust through various periods of time.

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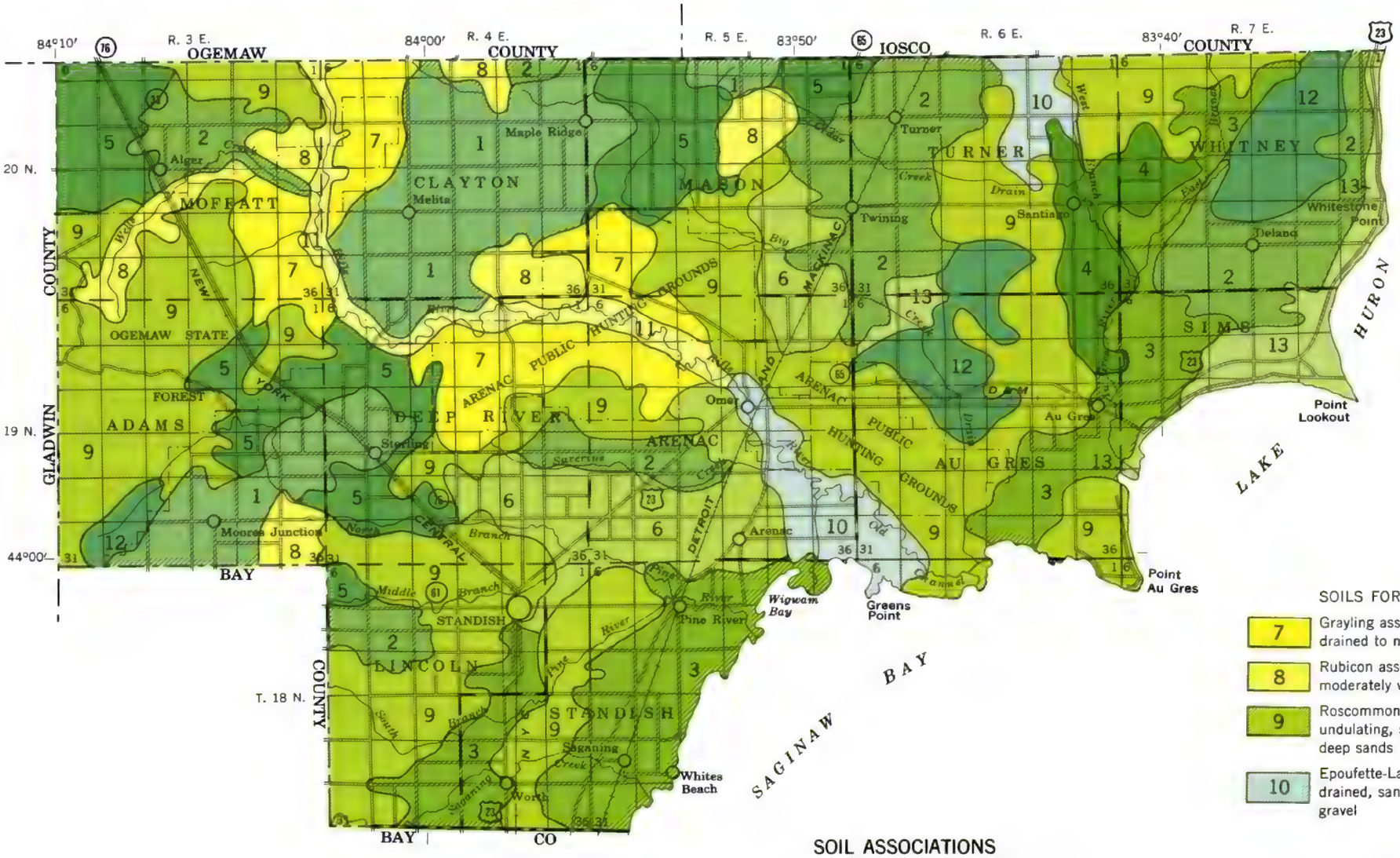

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MICHIGAN AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
ARENAC COUNTY, MICHIGAN

Scale 1:190,080

1 0 1 2 3 4 Miles

SOIL ASSOCIATIONS

DOMINANTLY SOILS THAT HAVE A LOAMY OR CLAYEY SUBSOIL

1 — Nester-Isabella-Kawkawlin-Twining association: Mainly level to sloping, well-drained to somewhat poorly drained soils from loamy glacial till

2 — Kawkawlin-Twining-Sims association: Mainly level to gently sloping, somewhat poorly drained to very poorly drained soils from clay loam and sandy clay loam glacial material

3 — Wisner-Sims association: Level or nearly level, poorly drained and very poorly drained soils formed in clay loam

4 — Charity-Pickford association: Level or nearly level, poorly drained and very poorly drained soils formed in clay or silty clay

SOILS FORMED IN SHALLOW, SANDY DEPOSITS OVER LOAMY OR CLAYEY MATERIAL

5 — Iosco-Kawkawlin-Sims association: Mainly nearly level to undulating, somewhat poorly drained and poorly drained soils formed in clay loam or in sand underlain by clay loam

6 — Allendale-Pinconning-Pickford association: Nearly level to undulating, somewhat poorly drained and poorly drained soils formed in sandy material over clay or silty clay or in clay or silty clay

SOILS FORMED IN SANDY OR LOAMY MATERIAL

7 — Grayling association: Nearly level to undulating, well drained to moderately well drained sands

8 — Rubicon association: Level to rolling, well drained to moderately well drained sands

9 — Roscommon-Au Gres association: Mainly level to gently undulating, somewhat poorly drained to very poorly drained, deep sands

10 — Epoufette-Lacota association: Nearly level, poorly drained, sandy or loamy soils underlain by limy sand and gravel

SOILS FROM ORGANIC DEPOSITS, BEACH SANDS, AND OTHER MATERIALS

11 — Rubicon-Gladwin-Nester association: Level to steep, well-drained to somewhat poorly drained soils from varied materials

12 — Tawas-Carbondale association: Shallow to deep, very poorly drained, organic soils in level to depressional areas

13 — Eastport association: Well-drained to poorly drained, sandy soils on low beach ridges and in swales

November 1965

INDEX TO MAP SHEETS
ARENAC COUNTY, MICHIGAN

Scale 1:190,080

1 0 1 2 3 4 Miles

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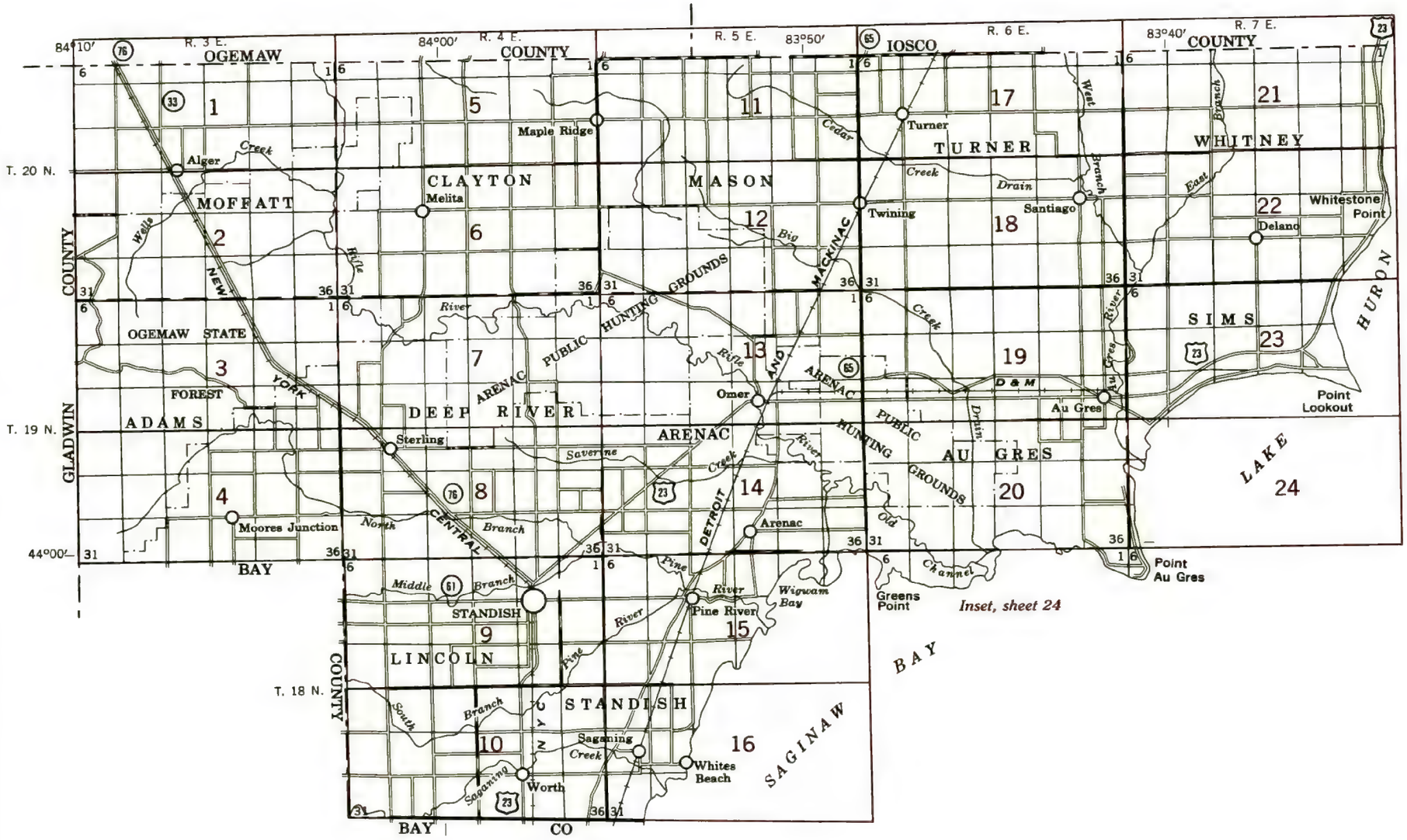

GUIDE TO MAPPING UNITS

[For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs.

See table 1, p. 7, for the approximate acreage and proportionate extent of the soils, and table 3, p. 73 for the predicted average acre yields of crops. For woodland suitability groups, see table 4, p. 76, and for information significant to engineering, see section beginning on p. 80. Dashes show that Gravel and sand pits and Stone quarries were not placed in a soil management unit, because they are not suited to crops. Mapping units AsA and AsB are shown as Arenac in material published by the Michigan Agricultural Experiment Station and units RpB, RpC, RtB, RtC, and RtD are shown as Melita]

Map symbol	Mapping unit	Described on page	Soil management group: Symbol	Soil management group: Page
Aa	Adrian muck	8	M/4c (IVw)	72
Ad	Adrian association	8	M/4c (IVw)	72
AeB	Adrian-Eastport-Rubicon association, undulating	9	5c (IVw)	69
AmA	Allendale loamy sand, 0 to 2 percent slopes	9	4/1b (IIIw)	66
AmB	Allendale loamy sand, 2 to 6 percent slopes	9	4/1b (IIIw)	66
An	Alluvial land, coarse	10	Lc (Vw)	71
Ao	Alluvial land, medium	10	Lc (Vw)	71
Ap	Alluvial land, moderately fine	10	Lc (Vw)	71
ArA	Au Gres sand, 0 to 2 percent slopes	10	5b (IVw)	69
ArB	Au Gres sand, 2 to 6 percent slopes	11	5b (IVw)	69
AsA	Au Gres sand, loamy substratum, 0 to 2 percent slopes	11	5/2b (IIIw)	70
AsB	Au Gres sand, loamy substratum, 2 to 6 percent slopes	11	5/2b (IIIw)	70
Au	Au Gres association	11	5b (IVw)	69
Aw	Au Gres-Roscommon association	11	5b (IVw)	69
Ax	Au Gres-Rubicon association	12	5b (IVw)	69
Ba	Bergland mucky loam	12	1c (IIIw)	62
BbA	Bohemian loamy fine sand, 0 to 2 percent slopes	13	3aA (IIs)	65
BbB	Bohemian loamy fine sand, 2 to 6 percent slopes	13	3aA (IIs)	65
BbC	Bohemian loamy fine sand, 6 to 12 percent slopes	13	3aA (IIs)	65
BcA	Bohemian very fine sandy loam, 0 to 2 percent slopes	13	3aA (IIs)	65
BcB	Bohemian very fine sandy loam, 2 to 6 percent slopes	13	3aA (IIs)	65
Bd	Bowers silty clay loam	14	1.5b (IIw)	64
Be	Bowers loam	13	1.5b (IIw)	64
Bf	Brevort fine sandy loam	14	4/2c (IIIw)	68
Bn	Brevort loamy sand	14	4/2c (IIIw)	68
Bo	Brevort sand	14	4/2c (IIIw)	68
Br	Brevort-Kawkawlin association	14	4/2c (IIIw)	68
Bs	Brevort-Roscommon association	15	4/2c (IIIw)	68
BtA	Brimley fine sandy loam, 0 to 2 percent slopes	15	3b (IIw)	65
BtB	Brimley fine sandy loam, 2 to 6 percent slopes	15	3b (IIw)	65
BuA	Brimley loam, 0 to 2 percent slopes	15	3b (IIw)	65
BuB	Brimley loam, 2 to 6 percent slopes	16	3b (IIw)	65
BvA	Brimley loamy fine sand, 0 to 2 percent slopes	16	3b (IIw)	65
BvB	Brimley loamy fine sand, 2 to 6 percent slopes	16	3b (IIw)	65
Bw	Bruce fine sandy loam	16	3c (IIw)	65
Bx	Bruce loamy fine sand	16	3c (IIw)	65
By	Bruce silt loam	17	3c (IIw)	65
Bz	Burleigh loamy sand	17	4c (IIIw)	66
Ca	Carbondale muck and peat	17	Mc (IIIw)	71
Ch	Charity silty clay loam	18	1c (IIIw)	62
Dg	Dawson-Greenwood peats	18	Mc-a (VIIIw)	71
Dm	Deford loam	18	4c (IIIw)	66
Dn	Deford loamy fine sand	19	4c (IIIw)	66
DuA	Duel loamy sand, 0 to 2 percent slopes	19	4/RaABC (IVs)	69
DuB	Duel loamy sand, 2 to 6 percent slopes	19	4/RaABC (IVs)	69
DuC	Duel loamy sand, 6 to 12 percent slopes	19	4/RaABC (IVs)	69
ErB	Eastport-Rubicon sands, 0 to 6 percent slopes	20	5.3aCF (VIIs)	70
ErC	Eastport-Rubicon sands, 6 to 12 percent slopes	20	5.3aCF (VIIs)	70
ErC2	Eastport-Rubicon sands, 6 to 12 percent slopes, moderately eroded	20	5.3aCF (VIIs)	70
ErD	Eastport-Rubicon sands, 12 to 18 percent slopes	20	5.3aCF (VIIs)	70
ErD2	Eastport-Rubicon sands, 12 to 18 percent slopes, moderately eroded	20	5.3aCF (VIIs)	70
ErE2	Eastport-Rubicon sands, 18 to 25 percent slopes, moderately eroded	21	5.3aCF (VIIs)	70
ErF	Eastport-Rubicon sands, 25 to 45 percent slopes	21	5.3aCF (VIIs)	70
EsC	Eastport-Rubicon association, rolling	21	5.3aCF (VIIs)	70
EtB	Eastport-Rubicon-Roscommon association, undulating	21	5.3aCF (VIIs)	70
Eu	Edwards muck	21	M/mc (IVw)	72
Ew	Epoufette sandy loam	22	4c (IIIw)	66
Ex	Essexville loamy fine sand	22	4/2c (IIIw)	68
Fm	Fresh water marsh	22	Sc (VIIIw)	72
Gm	Gladwin loamy sand	23	4b (IIIw)	66
GnB	Gladwin-Allendale association, undulating	23	4b (IIIw)	66
Gp	Gravel and sand pits	23	--------	--
Gr	Grayling association	23	5.7aAC (VIIs)	71
Gu	Gullied land	24	1.5aEF3 (VIIe)	64
Hc	Hettinger clay loam	24	1.5c (IIw)	64
Hg	Hettinger loam	24	1.5c (IIw)	64
Hn	Hettinger silty clay loam	25	1.5c (IIw)	64
IgA	Ingalls loamy sand, 0 to 2 percent slopes	25	4b (IIIw)	66
IgB	Ingalls loamy sand, 2 to 6 percent slopes	25	4b (IIIw)	66
ImA	Iosco loamy sand, 0 to 2 percent slopes	26	4/2b (IIIw)	68
ImB	Iosco loamy sand, 2 to 6 percent slopes	26	4/2b (IIIw)	68
IoA	Iosco sand, 0 to 2 percent slopes	26	4/2b (IIIw)	68
IoB	Iosco sand, 2 to 6 percent slopes	26	4/2b (IIIw)	68
IrB	Iosco-Rubicon association, undulating	26	4/2b (IIIw)	68
IuA	Isabella-Ubly loamy sands, 0 to 2 percent slopes	27	1.5aA (IIs)	62
IuB	Isabella-Ubly loamy sands, 2 to 6 percent slopes	27	1.5aB (IIe)	62
IuC	Isabella-Ubly loamy sands, 6 to 12 percent slopes	27	1.5aC (IIIe)	63
IuD	Isabella-Ubly loamy sands, 12 to 18 percent slopes	27	1.5aD (IVe)	63
IuF	Isabella-Ubly loamy sands, 25 to 55 percent slopes	27	1.5aF (VIIe)	64
IwA	Isabella-Ubly sandy loams, 0 to 2 percent slopes	28	1.5aA (IIs)	62
IwB	Isabella-Ubly sandy loams, 2 to 6 percent slopes	28	1.5aB (IIe)	62
IwB2	Isabella-Ubly sandy loams, 2 to 6 percent slopes, moderately eroded	28	1.5aB2 (IIIe)	62
IwC	Isabella-Ubly sandy loams, 6 to 12 percent slopes	28	1.5aC (IIIe)	63
IwC2	Isabella-Ubly sandy loams, 6 to 12 percent slopes, moderately eroded	28	1.5aC2 (IIIe)	63
KaA	Kawkawlin loam, 0 to 2 percent slopes	29	1.5b (IIw)	64
KaB	Kawkawlin loam, 2 to 6 percent slopes	29	1.5b (IIw)	64
KnA	Kent loam, 0 to 2 percent slopes	30	1aA (IIIs)	61
KnB	Kent loam, 2 to 6 percent slopes	30	1aB (IIIe)	61
KnC	Kent loam, 6 to 12 percent slopes	30	1aC (IIIe)	61
La	Lacota loam	30	1.5c (IIw)	64
Lb	Lacota sandy clay loam	31	1.5c (IIw)	64
Lc	Lacota silty clay loam	31	1.5c (IIw)	64
Lk	Lake beach	31	Sa (VIIIs)	72
Lm	Linwood peat and muck	31	M/3c (IIIw)	71
MaA	Mancelona loamy sand, 0 to 2 percent slopes	32	4aA (IIIs)	66
MaB	Mancelona loamy sand, 2 to 6 percent slopes	32	4aBC (IIIs)	66
MdA	Manistee loamy sand, 0 to 2 percent slopes	32	4/2aA (IIIs)	67
MdB	Manistee loamy sand, 2 to 6 percent slopes	33	4/2aB (IIIs)	67
Me	Markey muck	33	M/4c (IVw)	72
Mk	Maumee mucky loamy sand	33	5c (IVw)	69
Mm	Maumee mucky sandy loam	33	5c (IVw)	69
Mn	Maumee association	34	5c (IVw)	69
MoA	Menominee loamy sand, 0 to 2 percent slopes	34	4/2aA (IIIs)	67
MoB	Menominee loamy sand, 2 to 6 percent slopes	34	4/2aB (IIIs)	67
MoC	Menominee loamy sand, 6 to 12 percent slopes	34	4/2aC (IIIe)	68
MoD	Menominee loamy sand, 12 to 18 percent slopes	35	4/2aD (IVe)	68
MoE	Menominee loamy sand, 18 to 25 percent slopes	35	4/2aD (IVe)	68
MoF2	Menominee loamy sand, 25 to 45 percent slopes, moderately eroded	35	4/2aD (IVe)	68
MsA	Menominee sand, 0 to 2 percent slopes	35	4/2aA (IIIs)	67
MsB	Menominee sand, 2 to 6 percent slopes	35	4/2aB (IIIs)	67
MsC	Menominee sand, 6 to 12 percent slopes	35	4/2aC (IIIe)	68

GUIDE TO MAPPING UNITS--Continued

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Map symbol	Mapping unit	Described on page	Soil management group: Symbol	Soil management group: Page
NcC3	Nester clay loam, 6 to 12 percent slopes, severely eroded	36	1.5aCD3 (VIe)	63
NcD3	Nester clay loam, 12 to 18 percent slopes, severely eroded	36	1.5aCD3 (VIe)	63
NcE3	Nester clay loam, 18 to 25 percent slopes, severely eroded	36	1.5aEF3 (VIIe)	64
NcF3	Nester clay loam, 25 to 55 percent slopes, severely eroded	37	1.5aEF3 (VIIe)	64
NfA	Nester fine sandy loam, 0 to 2 percent slopes	37	1.5aA (IIs)	62
NfB	Nester fine sandy loam, 2 to 6 percent slopes	37	1.5aB (IIe)	62
NfB2	Nester fine sandy loam, 2 to 6 percent slopes, moderately eroded	37	1.5aB2 (IIIe)	62
NfC	Nester fine sandy loam, 6 to 12 percent slopes	37	1.5aC (IIIe)	63
NfC2	Nester fine sandy loam, 6 to 12 percent slopes, moderately eroded	37	1.5aC2 (IIIe)	63
NfD	Nester fine sandy loam, 12 to 18 percent slopes	38	1.5aD (IVe)	63
NfD2	Nester fine sandy loam, 12 to 18 percent slopes, moderately eroded	38	1.5aD (IVe)	63
NfE	Nester fine sandy loam, 18 to 25 percent slopes	38	1.5aE (VIe)	64
NfE2	Nester fine sandy loam, 18 to 25 percent slopes, moderately eroded	38	1.5aE (VIe)	64
NfF	Nester fine sandy loam, 25 to 55 percent slopes	38	1.5aF (VIIe)	64
NfF2	Nester fine sandy loam, 25 to 55 percent slopes, moderately eroded	38	1.5aF (VIIe)	64
NmB	Nester loam, 2 to 6 percent slopes	39	1.5aB (IIe)	62
NoB	Nester silty clay loam, 2 to 6 percent slopes	39	1.5aB (IIe)	62
NrE	Nester-Iosco-Rubicon association, steep	39	1.5aF (VIIe)	64
Pc	Pickford fine sandy loam	39	1c (IIIw)	62
Pd	Pickford loamy sand	39	1c (IIIw)	62
Pk	Pickford silty clay	40	1c (IIIw)	62
Pm	Pickford silty clay loam	40	1c (IIIw)	62
Ps	Pinconning loamy sand	40	4/1c (IIIw)	67
RaA	Richter loam, 0 to 2 percent slopes	41	3b (IIw)	65
RbA	Richter loamy sand, 0 to 2 percent slopes	41	3b (IIw)	65
RcA	Richter sandy loam, 0 to 2 percent slopes	41	3b (IIw)	65
RcB	Richter sandy loam, 2 to 6 percent slopes	41	3b (IIw)	65
Re	Richter association	42	3b (IIw)	65
Rf	Rifle peat	42	Mc (IIIw)	71
Rg	Roscommon loamy sand	42	5c (IVw)	69
Rh	Roscommon sand	42	5c (IVw)	69
Rk	Roscommon association	43	5c (IVw)	69
RmB	Roscommon-Au Gres-Rubicon association, undulating	43	5c (IVw)	69
RoA	Rousseau loamy fine sand, 0 to 2 percent slopes	43	4aA (IIIs)	66
RoB	Rousseau loamy fine sand, 2 to 6 percent slopes	43	4aBC (IIIs)	66
RoD	Rousseau loamy fine sand, 12 to 18 percent slopes	44	5/2aC (IVe)	70
RpB	Rubicon loamy sand, moderately fine substratum, 0 to 6 percent slopes	44	5/2aAB (IIIs)	70
RpC	Rubicon loamy sand, moderately fine substratum, 6 to 12 percent slopes	44	5/2aC (IVe)	70
RsB	Rubicon sand, 0 to 6 percent slopes	44	5.3aCF (VIIs)	70
RsC	Rubicon sand, 6 to 12 percent slopes	45	5.3aCF (VIIs)	70
RsD	Rubicon sand, 12 to 18 percent slopes	45	5.3aCF (VIIs)	70
RsE	Rubicon sand, 18 to 25 percent slopes	45	5.3aCF (VIIs)	70
RsF	Rubicon sand, 25 to 45 percent slopes	45	5.3aCF (VIIs)	70
RtB	Rubicon sand, moderately fine substratum, 0 to 6 percent slopes	45	5/2aAB (IIIs)	70
RtC	Rubicon sand, moderately fine substratum, 6 to 12 percent slopes	45	5/2aC (IVe)	70
RtD	Rubicon sand, moderately fine substratum, 12 to 18 percent slopes	45	5/2aC (IVe)	70
RuB	Rubicon association, undulating	45	5.3aCF (VIIs)	70
RuC	Rubicon association, rolling	46	5.3aCF (VIIs)	70
RvB	Rubicon-Iosco association, undulating	46	5/2aAB (IIIs)	70
RyA	Rudyard silty clay loam, 0 to 2 percent slopes	46	1b (IIIw)	61
Sa	Saganing sandy loam	47	4c (IIIw)	66
Sb	Saugatuck loamy sand	47	5b-h (VIIw)	69
Sc	Saugatuck sand	47	5b-h (VIIw)	69
SdA	Selkirk fine sandy loam, 0 to 2 percent slopes	48	1b (IIIw)	61
SeA	Selkirk loam, 0 to 2 percent slopes	48	1b (IIIw)	61
SeB	Selkirk loam, 2 to 6 percent slopes	48	1b (IIIw)	61
SfA	Selkirk loamy sand, 0 to 2 percent slopes	48	1b (IIIw)	61
SkA	Selkirk silt loam, 0 to 2 percent slopes	48	1b (IIIw)	61
SlA	Selkirk silty clay loam, 0 to 2 percent slopes	49	1b (IIIw)	61
Sm	Sims clay loam	49	1.5c (IIw)	64
Sn	Sims loam	49	1.5c (IIw)	64
Sp	Sims loamy sand	49	1.5c (IIw)	64
Sr	Sims sandy loam	49	1.5c (IIw)	64
Su	Stone quarries	50	----------	--
SvA	Summerville sandy loam, 0 to 2 percent slopes	50	RaAB (VIIs)	72
SvB	Summerville sandy loam, 2 to 6 percent slopes	51	RaAB (VIIs)	72
Ta	Tawas peat and muck	51	M/4c (IVw)	72
Tb	Tawas peat, burned	51	M/4c (IVw)	72
Tc	Tawas association	51	M/4c (IVw)	72
Td	Tawas-Carbondale association	51	M/4c (IVw)	72
Te	Tawas-Roscommon association	52	M/4c (IVw)	72
Tf	Tobico loamy fine sand	52	5c (IVw)	69
Tg	Tobico sandy loam	52	5c (IVw)	69
Th	Tonkey loam	53	3c (IIw)	65
Tk	Tonkey loamy sand	53	3c (IIw)	65
Tm	Tonkey sandy loam	53	3c (IIw)	65
TnA	Twining loam, 0 to 2 percent slopes	53	1.5b (IIw)	64
TsA	Twining-Belding loamy sands, 0 to 2 percent slopes	53	1.5b (IIw)	64
TsB	Twining-Belding loamy sands, 2 to 6 percent slopes	54	1.5b (IIw)	64
TwA	Twining-Belding sandy loams, 0 to 2 percent slopes	54	1.5b (IIw)	64
TwB	Twining-Belding sandy loams, 2 to 6 percent slopes	55	1.5b (IIw)	64
WaA	Wainola loamy fine sand, 0 to 2 percent slopes	55	4b (IIIw)	66
WaB	Wainola loamy fine sand, 2 to 6 percent slopes	56	4b (IIIw)	66
Wk	Warners muck and marl	56	M/mc (IVw)	72
Wm	Willette muck	56	M/1c (IIIw)	71
Wn	Wisner clay loam	57	1.5c (IIw)	64
Wo	Wisner loam	57	1.5c (IIw)	64
Ws	Wisner sandy loam	57	1.5c (IIw)	64

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GUIDE TO MAPPING UNITS--Continued

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Map symbol	Mapping unit	Described on page	Soil management group: Symbol	Soil management group: Page
NcC3	Nester clay loam, 6 to 12 percent slopes, severely eroded	36	1.5aCD3 (VIe)	63
NcD3	Nester clay loam, 12 to 18 percent slopes, severely eroded	36	1.5aCD3 (VIe)	63
NcE3	Nester clay loam, 18 to 25 percent slopes, severely eroded	36	1.5aEF3 (VIIe)	64
NcF3	Nester clay loam, 25 to 55 percent slopes, severely eroded	37	1.5aEF3 (VIIe)	64
NfA	Nester fine sandy loam, 0 to 2 percent slopes	37	1.5aA (IIs)	62
NfB	Nester fine sandy loam, 2 to 6 percent slopes	37	1.5aB (IIe)	62
NfB2	Nester fine sandy loam, 2 to 6 percent slopes, moderately eroded	37	1.5aB2 (IIIe)	62
NfC	Nester fine sandy loam, 6 to 12 percent slopes	37	1.5aC (IIIe)	63
NfC2	Nester fine sandy loam, 6 to 12 percent slopes, moderately eroded	37	1.5aC2 (IIIe)	63
NfD	Nester fine sandy loam, 12 to 18 percent slopes	38	1.5aD (IVe)	63
NfD2	Nester fine sandy loam, 12 to 18 percent slopes, moderately eroded	38	1.5aD (IVe)	63
NfE	Nester fine sandy loam, 18 to 25 percent slopes	38	1.5aE (VIe)	64
NfE2	Nester fine sandy loam, 18 to 25 percent slopes, moderately eroded	38	1.5aE (VIe)	64
NfF	Nester fine sandy loam, 25 to 55 percent slopes	38	1.5aF (VIIe)	64
NfF2	Nester fine sandy loam, 25 to 55 percent slopes, moderately eroded	38	1.5aF (VIIe)	64
NmB	Nester loam, 2 to 6 percent slopes	39	1.5aB (IIe)	62
NoB	Nester silty clay loam, 2 to 6 percent slopes	39	1.5aB (IIe)	62
NrE	Nester-Iosco-Rubicon association, steep	39	1.5aF (VIIe)	64
Pc	Pickford fine sandy loam	39	1c (IIIw)	62
Pd	Pickford loamy sand	39	1c (IIIw)	62
Pk	Pickford silty clay	40	1c (IIIw)	62
Pm	Pickford silty clay loam	40	1c (IIIw)	62
Ps	Pinconning loamy sand	40	4/1c (IIIw)	67
RaA	Richter loam, 0 to 2 percent slopes	41	3b (IIw)	65
RbA	Richter loamy sand, 0 to 2 percent slopes	41	3b (IIw)	65
RcA	Richter sandy loam, 0 to 2 percent slopes	41	3b (IIw)	65
RcB	Richter sandy loam, 2 to 6 percent slopes	41	3b (IIw)	65
Re	Richter association	42	3b (IIw)	65
Rf	Rifle peat	42	Mc (IIIw)	71
Rg	Roscommon loamy sand	42	5c (IVw)	69
Rh	Roscommon sand	42	5c (IVw)	69
Rk	Roscommon association	43	5c (IVw)	69
RmB	Roscommon-Au Gres-Rubicon association, undulating	43	5c (IVw)	69
RoA	Rousseau loamy fine sand, 0 to 2 percent slopes	43	4aA (IIIs)	66
RoB	Rousseau loamy fine sand, 2 to 6 percent slopes	43	4aBC (IIIs)	66
RoD	Rousseau loamy fine sand, 12 to 18 percent slopes	44	5/2aC (IVe)	70
RpB	Rubicon loamy sand, moderately fine substratum, 0 to 6 percent slopes	44	5/2aAB (IIIs)	70
RpC	Rubicon loamy sand, moderately fine substratum, 6 to 12 percent slopes	44	5/2aC (IVe)	70
RsB	Rubicon sand, 0 to 6 percent slopes	44	5.3aCF (VIIs)	70
RsC	Rubicon sand, 6 to 12 percent slopes	45	5.3aCF (VIIs)	70
RsD	Rubicon sand, 12 to 18 percent slopes	45	5.3aCF (VIIs)	70
RsE	Rubicon sand, 18 to 25 percent slopes	45	5.3aCF (VIIs)	70
RsF	Rubicon sand, 25 to 45 percent slopes	45	5.3aCF (VIIs)	70
RtB	Rubicon sand, moderately fine substratum, 0 to 6 percent slopes	45	5/2aAB (IIIs)	70
RtC	Rubicon sand, moderately fine substratum, 6 to 12 percent slopes	45	5/2aC (IVe)	70
RtD	Rubicon sand, moderately fine substratum, 12 to 18 percent slopes	45	5/2aC (IVe)	70
RuB	Rubicon association, undulating	45	5.3aCF (VIIs)	70
RuC	Rubicon association, rolling	46	5.3aCF (VIIs)	70
RvB	Rubicon-Iosco association, undulating	46	5/2aAB (IIIs)	70
RyA	Rudyard silty clay loam, 0 to 2 percent slopes	46	1b (IIIw)	61
Sa	Saganing sandy loam	47	4c (IIIw)	66
Sb	Saugatuck loamy sand	47	5b-h (VIIw)	69
Sc	Saugatuck sand	47	5b-h (VIIw)	69
SdA	Selkirk fine sandy loam, 0 to 2 percent slopes	48	1b (IIIw)	61
SeA	Selkirk loam, 0 to 2 percent slopes	48	1b (IIIw)	61
SeB	Selkirk loam, 2 to 6 percent slopes	48	1b (IIIw)	61
SfA	Selkirk loamy sand, 0 to 2 percent slopes	48	1b (IIIw)	61
SkA	Selkirk silt loam, 0 to 2 percent slopes	48	1b (IIIw)	61
SlA	Selkirk silty clay loam, 0 to 2 percent slopes	49	1b (IIIw)	61
Sm	Sims clay loam	49	1.5c (IIw)	64
Sn	Sims loam	49	1.5c (IIw)	64
Sp	Sims loamy sand	49	1.5c (IIw)	64
Sr	Sims sandy loam	49	1.5c (IIw)	64
Su	Stone quarries	50	----------	--
SvA	Summerville sandy loam, 0 to 2 percent slopes	50	RaAB (VIIs)	72
SvB	Summerville sandy loam, 2 to 6 percent slopes	51	RaAB (VIIs)	72
Ta	Tawas peat and muck	51	M/4c (IVw)	72
Tb	Tawas peat, burned	51	M/4c (IVw)	72
Tc	Tawas association	51	M/4c (IVw)	72
Td	Tawas-Carbondale association	51	M/4c (IVw)	72
Te	Tawas-Roscommon association	52	M/4c (IVw)	72
Tf	Tobico loamy fine sand	52	5c (IVw)	69
Tg	Tobico sandy loam	52	5c (IVw)	69
Th	Tonkey loam	53	3c (IIw)	65
Tk	Tonkey loamy sand	53	3c (IIw)	65
Tm	Tonkey sandy loam	53	3c (IIw)	65
TnA	Twining loam, 0 to 2 percent slopes	53	1.5b (IIw)	64
TsA	Twining-Belding loamy sands, 0 to 2 percent slopes	53	1.5b (IIw)	64
TsB	Twining-Belding loamy sands, 2 to 6 percent slopes	54	1.5b (IIw)	64
TwA	Twining-Belding sandy loams, 0 to 2 percent slopes	54	1.5b (IIw)	64
TwB	Twining-Belding sandy loams, 2 to 6 percent slopes	55	1.5b (IIw)	64
WaA	Wainola loamy fine sand, 0 to 2 percent slopes	55	4b (IIIw)	66
WaB	Wainola loamy fine sand, 2 to 6 percent slopes	56	4b (IIIw)	66
Wk	Warners muck and marl	56	M/mc (IVw)	72
Wm	Willette muck	56	M/1c (IIIw)	71
Wn	Wisner clay loam	57	1.5c (IIw)	64
Wo	Wisner loam	57	1.5c (IIw)	64
Ws	Wisner sandy loam	57	1.5c (IIw)	64

212-451 O - 67 (Face p. 142) No. 1

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital, A, B, C, D, E, or F, shows the slope. Most symbols without a slope letter are those for nearly level soils or land types, but some, such as Gu for Gullied land, designate soils or land types that have a considerable range in slope. A final number, 2 or 3, in the symbol shows that the soil is moderately or severely eroded.

SYMBOL	NAME
Aa	Adrian muck
Ad	Adrian association
AeB	Adrian–Eastport–Rubicon association, undulating
AmA	Allendale loamy sand, 0 to 2 percent slopes
AmB	Allendale loamy sand, 2 to 6 percent slopes
An	Alluvial land, coarse
Ao	Alluvial land, medium
Ap	Alluvial land, moderately fine
ArA	Au Gres sand, 0 to 2 percent slopes
ArB	Au Gres sand, 2 to 6 percent slopes
AsA	Au Gres sand, loamy substratum, 0 to 2 percent slopes
AsB	Au Gres sand, loamy substratum, 2 to 6 percent slopes
Au	Au Gres association
Aw	Au Gres–Roscommon association
Ax	Au Gres–Rubicon association
Ba	Bergland mucky loam
BbA	Bohemian loamy fine sand, 0 to 2 percent slopes
BbB	Bohemian loamy fine sand, 2 to 6 percent slopes
BbC	Bohemian loamy fine sand, 6 to 12 percent slopes
BcA	Bohemian very fine sandy loam, 0 to 2 percent slopes
BcB	Bohemian very fine sandy loam, 2 to 6 percent slopes
Bd	Bowers silty clay loam
Be	Bowers loam
Bf	Brevort fine sandy loam
Bn	Brevort loamy sand
Bo	Brevort sand
Br	Brevort–Kawkawlin association
Bs	Brevort–Roscommon association
BtA	Brimley fine sandy loam, 0 to 2 percent slopes
BtB	Brimley fine sandy loam, 2 to 6 percent slopes
BuA	Brimley loam, 0 to 2 percent slopes
BuB	Brimley loam, 2 to 6 percent slopes
BvA	Brimley loamy fine sand, 0 to 2 percent slopes
BvB	Brimley loamy fine sand, 2 to 6 percent slopes
Bw	Bruce fine sandy loam
Bx	Bruce loamy fine sand
By	Bruce silt loam
Bz	Burleigh loamy sand
Ca	Carbondale muck and peat
Ch	Charity silty clay loam
Dg	Dawson–Greenwood peats
Dm	Deford loam
Dn	Deford loamy fine sand
DuA	Duel loamy sand, 0 to 2 percent slopes
DuB	Duel loamy sand, 2 to 6 percent slopes
DuC	Duel loamy sand, 6 to 12 percent slopes
ErB	Eastport–Rubicon sands, 0 to 6 percent slopes
ErC	Eastport–Rubicon sands, 6 to 12 percent slopes
ErC2	Eastport–Rubicon sands, 6 to 12 percent slopes, moderately eroded
ErD	Eastport–Rubicon sands, 12 to 18 percent slopes
ErD2	Eastport–Rubicon sands, 12 to 18 percent slopes, moderately eroded
ErE2	Eastport–Rubicon sands, 18 to 25 percent slopes, moderately eroded
ErF	Eastport–Rubicon sands, 25 to 45 percent slopes
EsC	Eastport–Rubicon association, rolling
ErB	Eastport–Rubicon–Roscommon association, undulating
Eu	Edwards muck
Ew	Epoufette sandy loam
Ex	Essexville loamy fine sand
Fm	Fresh water marsh
Gm	Glodwin loamy sand
GnB	Glodwin–Allendale association, undulating
Gp	Gravel and sand pits
Gr	Grayling association
Gu	Gullied land
Hc	Hettinger clay loam
Hg	Hettinger loam
Hn	Hettinger silty clay loam
IgA	Ingalls loamy sand, 0 to 2 percent slopes
IgB	Ingalls loamy sand, 2 to 6 percent slopes
ImA	Iosco loamy sand, 0 to 2 percent slopes
ImB	Iosco loamy sand, 2 to 6 percent slopes
IoA	Iosco sand, 0 to 2 percent slopes
IoB	Iosco sand, 2 to 6 percent slopes
IrB	Iosco–Rubicon association, undulating
IuA	Isabella–Ubly loamy sands, 0 to 2 percent slopes
IuB	Isabella–Ubly loamy sands, 2 to 6 percent slopes
IuC	Isabella–Ubly loamy sands, 6 to 12 percent slopes
IuD	Isabella–Ubly loamy sands, 12 to 18 percent slopes
IuF	Isabella–Ubly loamy sands, 25 to 55 percent slopes
IwA	Isabella–Ubly sandy loams, 0 to 2 percent slopes
IwB	Isabella–Ubly sandy loams, 2 to 6 percent slopes
IwB2	Isabella–Ubly sandy loams, 2 to 6 percent slopes, moderately eroded
IwC	Isabella–Ubly sandy loams, 6 to 12 percent slopes
IwC2	Isabella–Ubly sandy loams, 6 to 12 percent slopes, moderately eroded
KaA	Kawkawlin loam, 0 to 2 percent slopes
KaB	Kawkawlin loam, 2 to 6 percent slopes
KnA	Kent loam, 0 to 2 percent slopes
KnB	Kent loam, 2 to 6 percent slopes
KnC	Kent loam, 6 to 12 percent slopes
La	Lacota loam
Lb	Lacota sandy clay loam
Lc	Lacota silty clay loam
Lk	Lake beach
Lm	Linwood peat and muck
MaA	Mancelona loamy sand, 0 to 2 percent slopes
MaB	Mancelona loamy sand, 2 to 6 percent slopes
MdA	Manistee loamy sand, 0 to 2 percent slopes
MdB	Manistee loamy sand, 2 to 6 percent slopes
Me	Markey muck
Mk	Maumee mucky loamy sand
Mm	Maumee mucky sandy loam
Mn	Maumee association
MoA	Menominee loamy sand, 0 to 2 percent slopes
MoB	Menominee loamy sand, 2 to 6 percent slopes
MoC	Menominee loamy sand, 6 to 12 percent slopes
MoD	Menominee loamy sand, 12 to 18 percent slopes
MoE	Menominee loamy sand, 18 to 25 percent slopes
MoF2	Menominee loamy sand, 25 to 45 percent slopes, moderately eroded
MsA	Menominee sand, 0 to 2 percent slopes
MsB	Menominee sand, 2 to 6 percent slopes
MsC	Menominee sand, 6 to 12 percent slopes
NcC3	Nester clay loam, 6 to 12 percent slopes, severely eroded
NcD3	Nester clay loam, 12 to 18 percent slopes, severely eroded
NcE3	Nester clay loam, 18 to 25 percent slopes, severely eroded
NcF3	Nester clay loam, 25 to 55 percent slopes, severely eroded
NfA	Nester fine sandy loam, 0 to 2 percent slopes
NfB	Nester fine sandy loam, 2 to 6 percent slopes
NfB2	Nester fine sandy loam, 2 to 6 percent slopes, moderately eroded
NfC	Nester fine sandy loam, 6 to 12 percent slopes
NfC2	Nester fine sandy loam, 6 to 12 percent slopes, moderately eroded
NfD	Nester fine sandy loam, 12 to 18 percent slopes
NfD2	Nester fine sandy loam, 12 to 18 percent slopes, moderately eroded
NfE	Nester fine sandy loam, 18 to 25 percent slopes
NfE2	Nester fine sandy loam, 18 to 25 percent slopes, moderately eroded
NfF	Nester fine sandy loam, 25 to 55 percent slopes
NfF2	Nester fine sandy loam, 25 to 55 percent slopes, moderately eroded
NmB	Nester loam, 2 to 6 percent slopes
NoB	Nester silty clay loam, 2 to 6 percent slopes
NrE	Nester–Iosco–Rubicon association, steep
Pc	Pickford fine sandy loam
Pd	Pickford loamy sand
Pk	Pickford silty clay
Pm	Pickford silty clay loam
Ps	Pinconning loamy sand
RaA	Richter loam, 0 to 2 percent slopes
RbA	Richter loamy sand, 0 to 2 percent slopes
RcA	Richter sandy loam, 0 to 2 percent slopes
RcB	Richter sandy loam, 2 to 6 percent slopes
Re	Richter association
Rf	Rifle peat
Rg	Roscommon loamy sand
Rh	Roscommon sand
Rk	Roscommon association
RmB	Roscommon–Au Gres–Rubicon association, undulating
RoA	Rousseau loamy fine sand, 0 to 2 percent slopes
RoB	Rousseau loamy fine sand, 2 to 6 percent slopes
RoD	Rousseau loamy fine sand, 12 to 18 percent slopes
RpB	Rubicon loamy sand, moderately fine substratum, 0 to 6 percent slopes
RpC	Rubicon loamy sand, moderately fine substratum, 6 to 12 percent slopes
RsB	Rubicon sand, 0 to 6 percent slopes
RsC	Rubicon sand, 6 to 12 percent slopes
RsD	Rubicon sand, 12 to 18 percent slopes
RsE	Rubicon sand, 18 to 25 percent slopes
RsF	Rubicon sand, 25 to 45 percent slopes
RtB	Rubicon sand, moderately fine substratum, 0 to 6 percent slopes
RtC	Rubicon sand, moderately fine substratum, 6 to 12 percent slopes
RtD	Rubicon sand, moderately fine substratum, 12 to 18 percent slopes
RuB	Rubicon association, undulating
RuC	Rubicon association, rolling
RvB	Rubicon–Iosco association, undulating
RyA	Rudyard silty clay loam, 0 to 2 percent slopes
Sa	Saganing sandy loam
Sb	Saugatuck loamy sand
Sc	Saugatuck sand
SdA	Selkirk fine sandy loam, 0 to 2 percent slopes
SeA	Selkirk loam, 0 to 2 percent slopes
SeB	Selkirk loam, 2 to 6 percent slopes
SfA	Selkirk loamy sand, 0 to 2 percent slopes
SkA	Selkirk silt loam, 0 to 2 percent slopes
SlA	Selkirk silty clay loam, 0 to 2 percent slopes
Sm	Sims clay loam
Sn	Sims loam
Sp	Sims loamy sand
Sr	Sims sandy loam
Su	Stone quarries
SvA	Summerville sandy loam, 0 to 2 percent slopes
SvB	Summerville sandy loam, 2 to 6 percent slopes
Ta	Tawas peat and muck
Tb	Tawas peat, burned
Tc	Tawas association
Td	Tawas–Carbondale association
Te	Tawas–Roscommon association
Tf	Tobico loamy fine sand
Tg	Tobico sandy loam
Th	Tonkey loam
Tk	Tonkey loamy sand
Tm	Tonkey sandy loam
TnA	Twining loam, 0 to 2 percent slopes
TsA	Twining–Belding loamy sands, 0 to 2 percent slopes
TsB	Twining–Belding loamy sands, 2 to 6 percent slopes
TwA	Twining–Belding sandy loams, 0 to 2 percent slopes
TwB	Twining–Belding sandy loams, 2 to 6 percent slopes
WaA	Wainola loamy fine sand, 0 to 2 percent slopes
WaB	Wainola loamy fine sand, 2 to 6 percent slopes
Wk	Warners muck and marl
Wm	Willette muck
Wn	Wisner clay loam
Wo	Wisner loam
Ws	Wisner sandy loam

Soil map constructed 1965 by Cartographic Division, Soil Conservation Service, USDA, from 1953 aerial photographs. Controlled mosaic based on Michigan plane coordinate system, east zone, transverse Mercator projection, 1927 North American datum.

ARENAC COUNTY, MICHIGAN — SHEET NUMBER 1

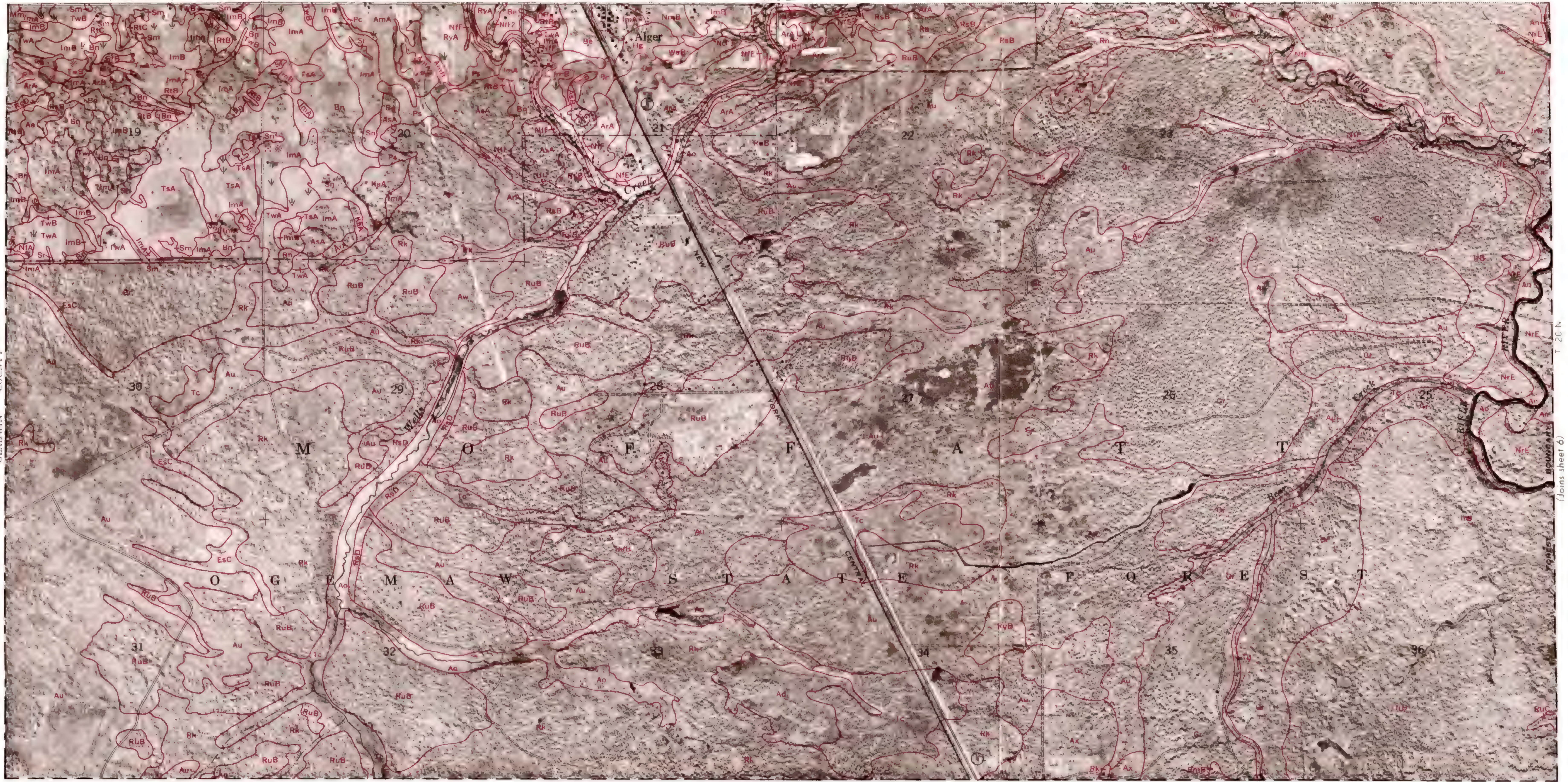
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Michigan Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

2

(Joins sheet 1)



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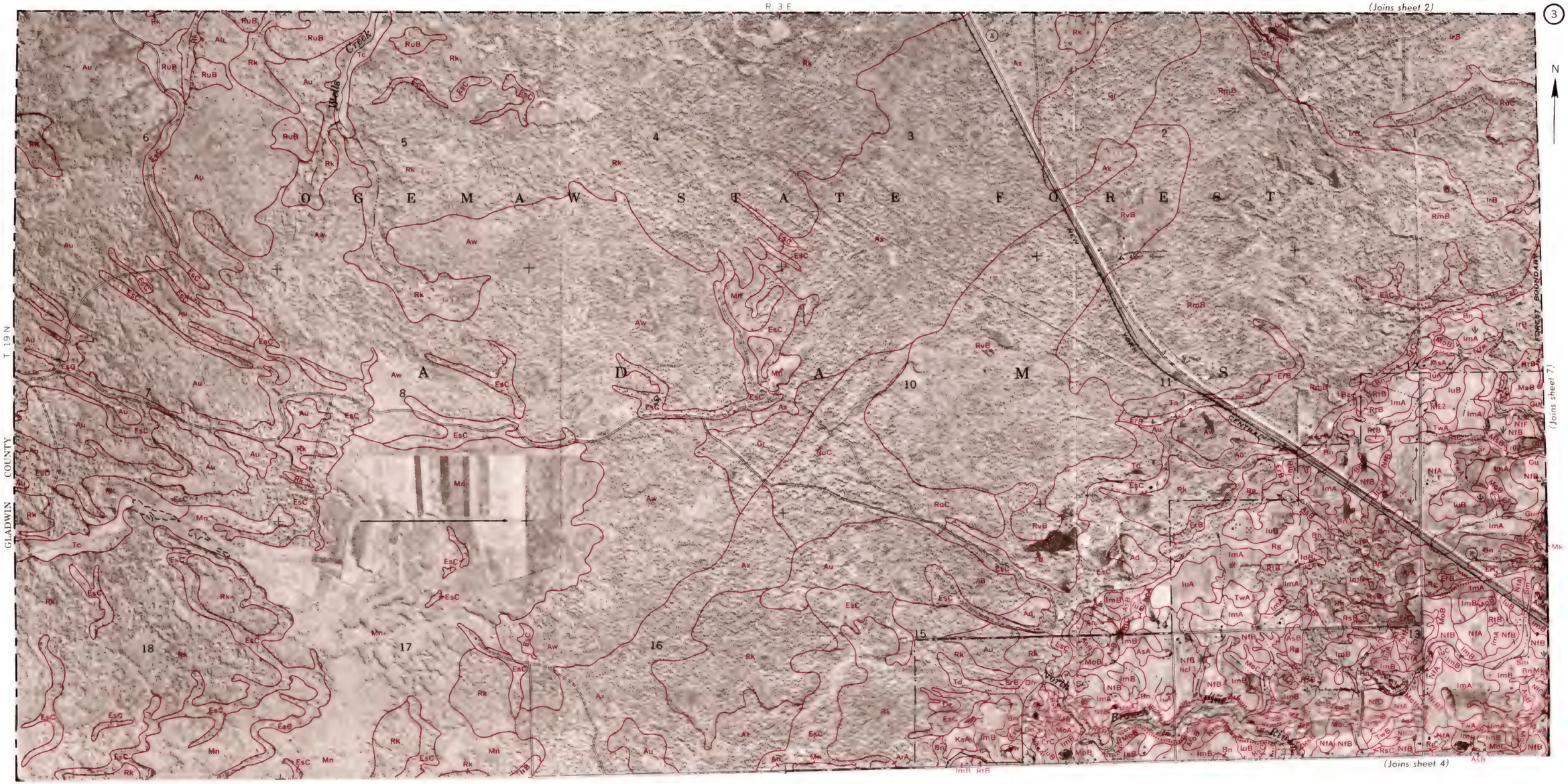

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture and the Michigan Agricultural Experiment Station

Range, township, and section corners shown on this map are indefinite

ARENAC COUNTY, MICHIGAN — SHEET NUMBER 4

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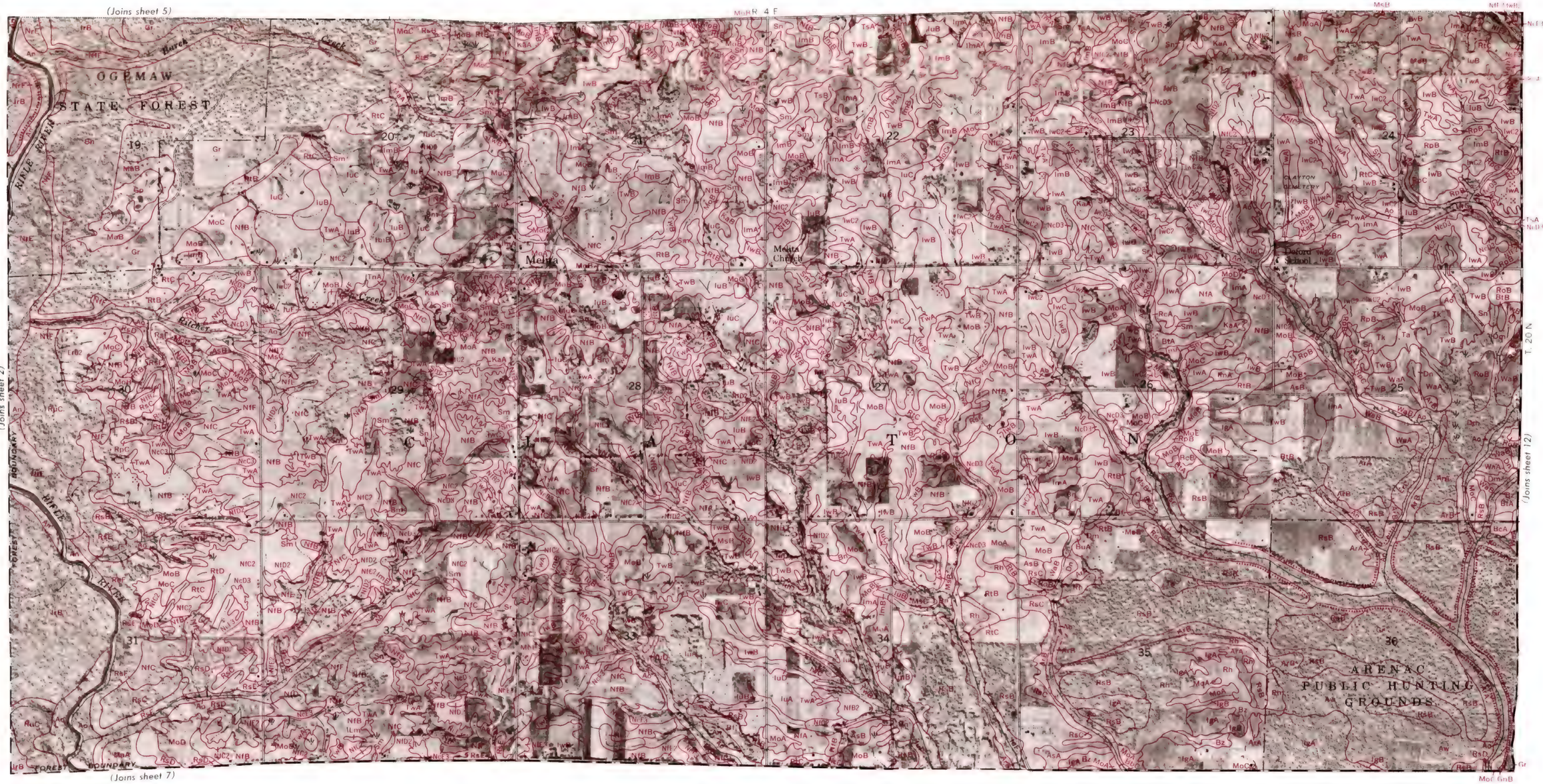
Range, township, and section corners shown on this map are indefinite

ARENAC COUNTY, MICHIGAN — SHEET NUMBER 6



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

ARENAC COUNTY, MICHIGAN — SHEET NUMBER 7

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Michigan Agricultural Experiment Station

Range, township, and section corners shown on this map are indefinite.

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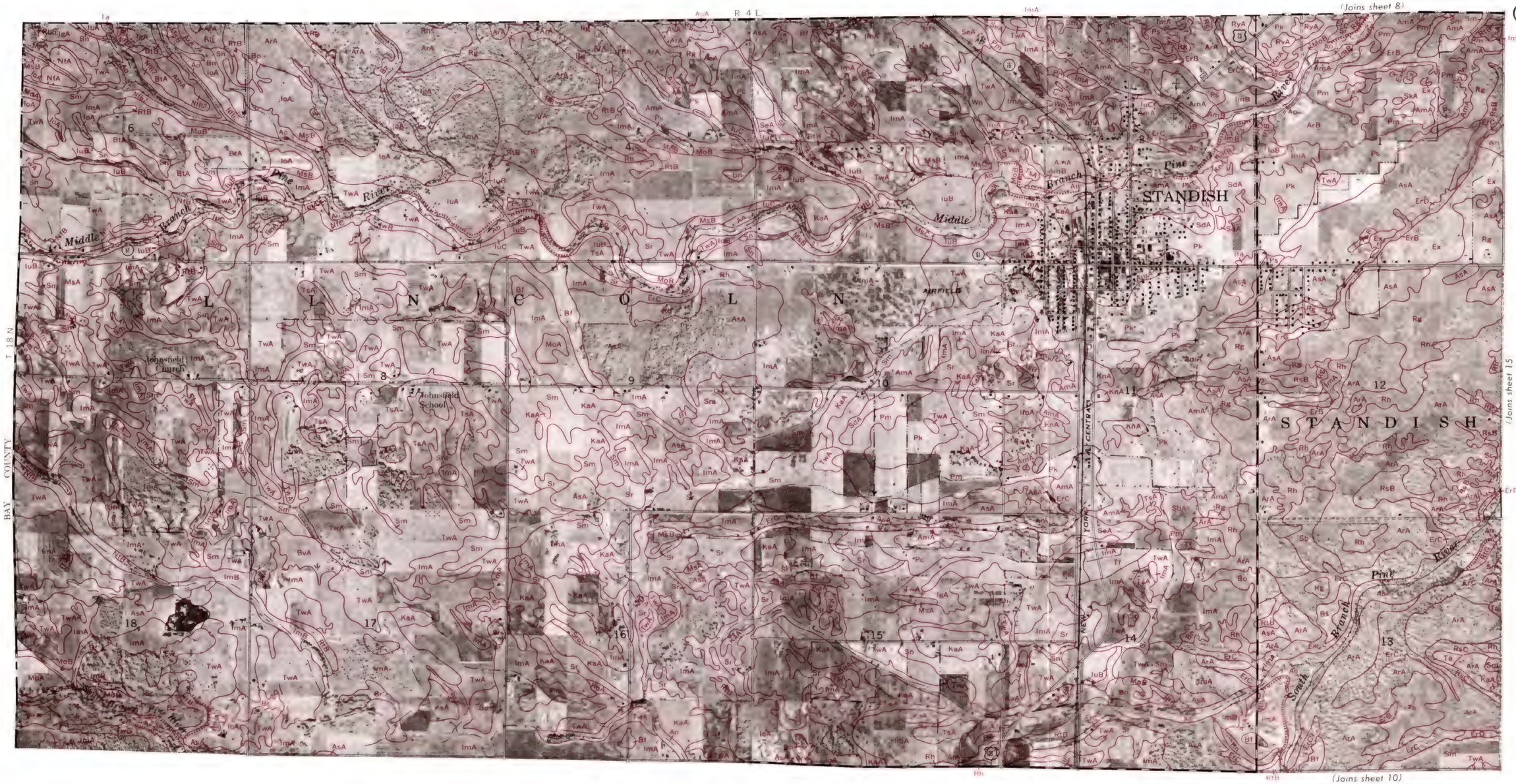


This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture and the Michigan Agricultural Experiment Station

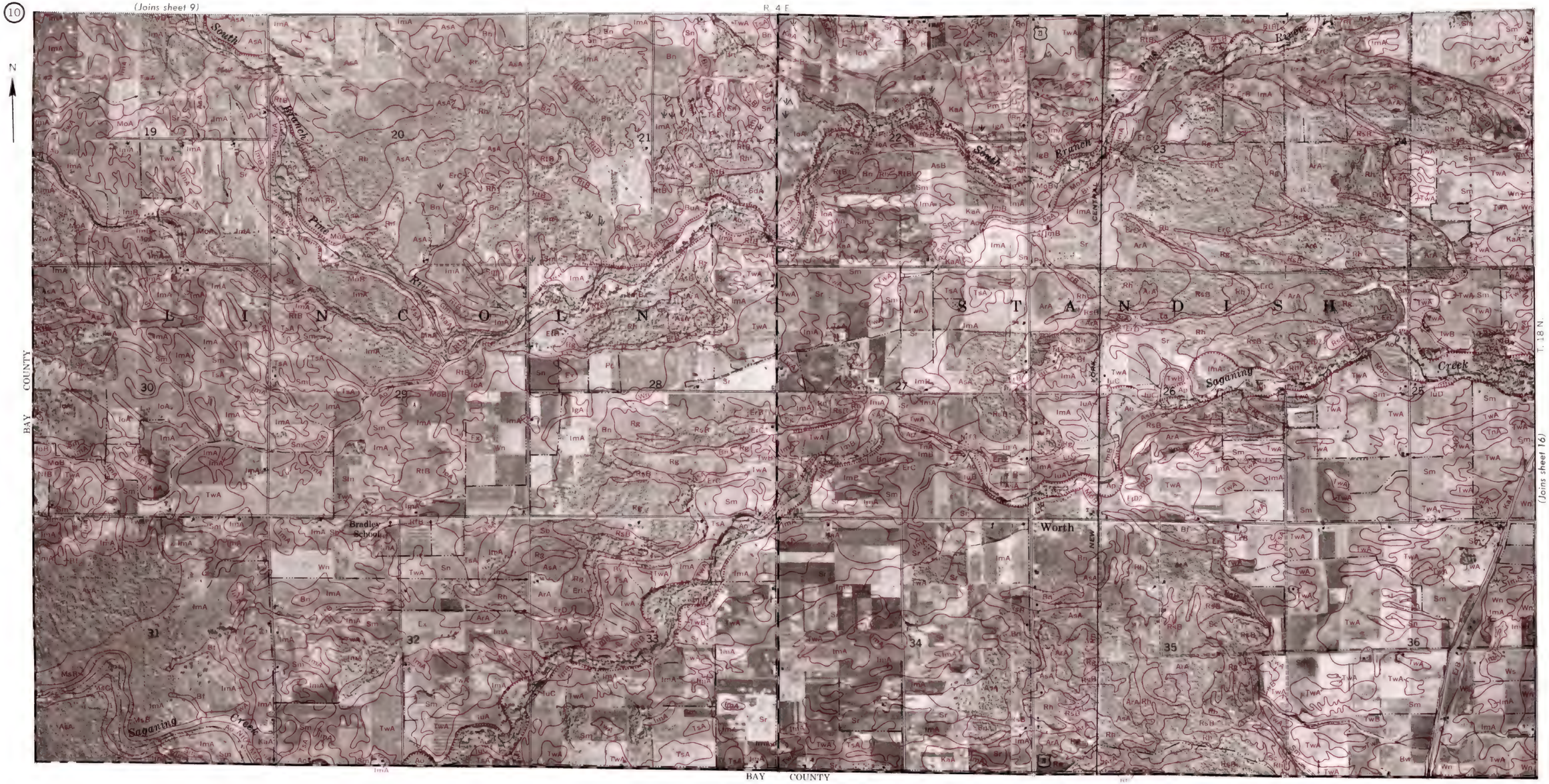
Range, township, and section corners shown on this map are indefinite

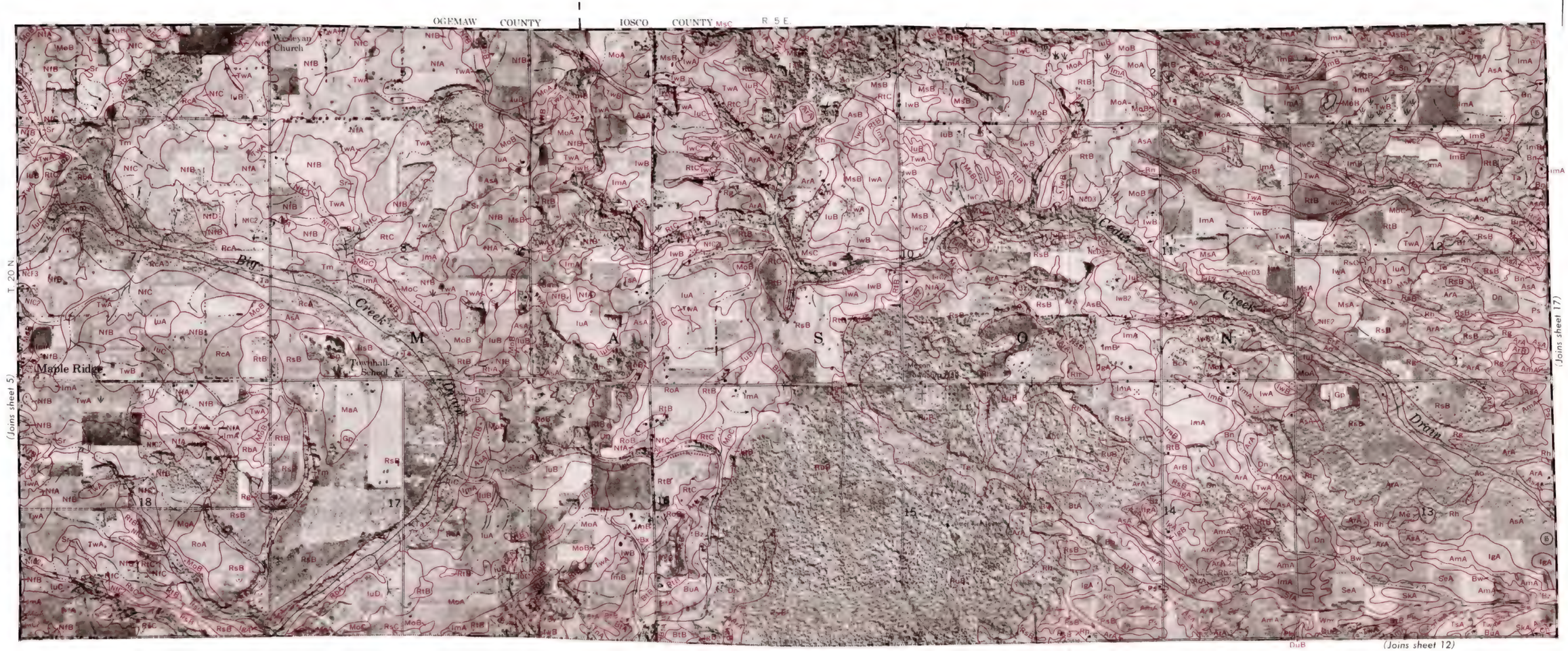
0 ½ 1 Mile

Scale 1: 20 000

0 5000 Feet

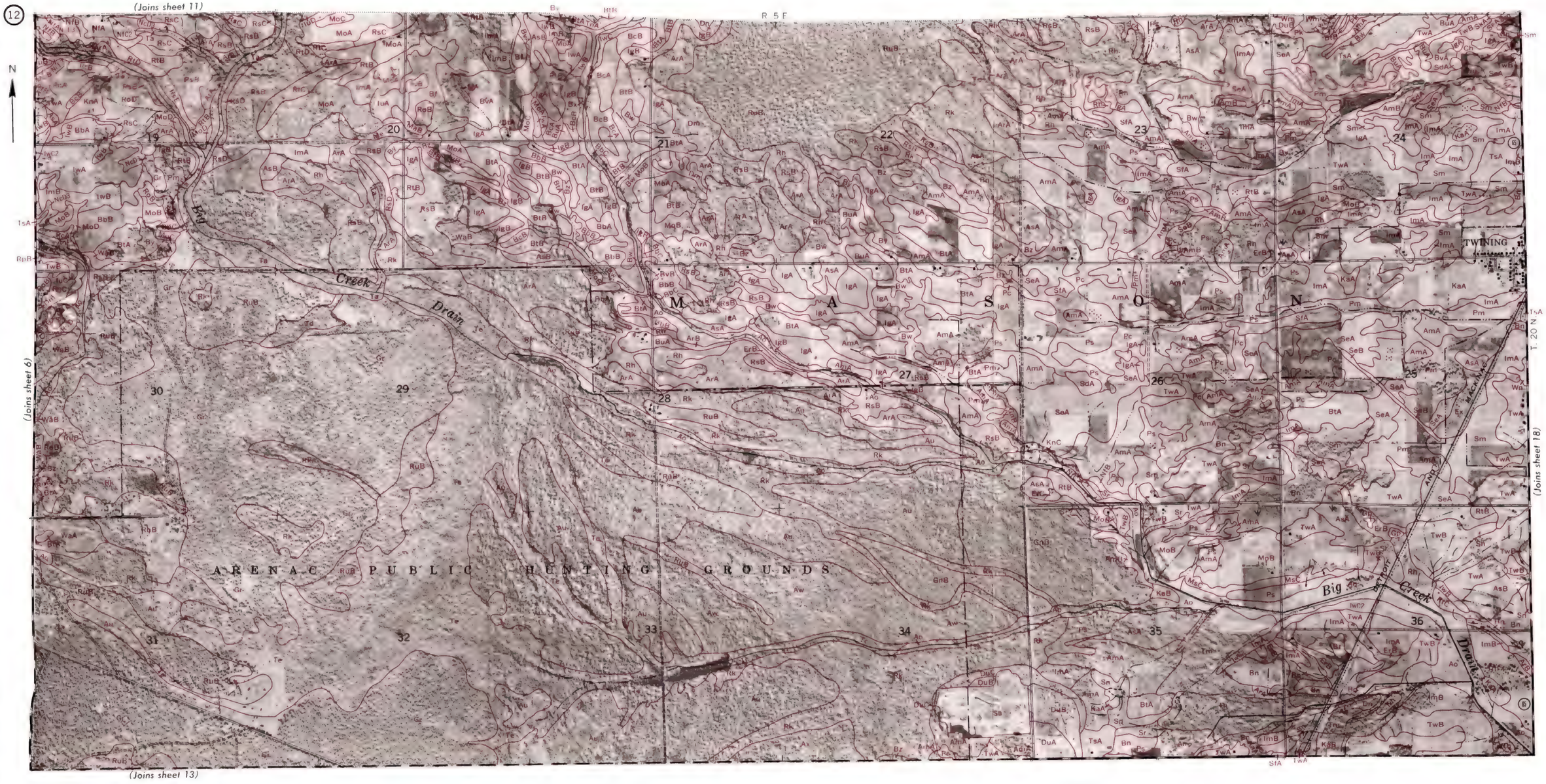
ARENAC COUNTY, MICHIGAN — SHEET NUMBER 10





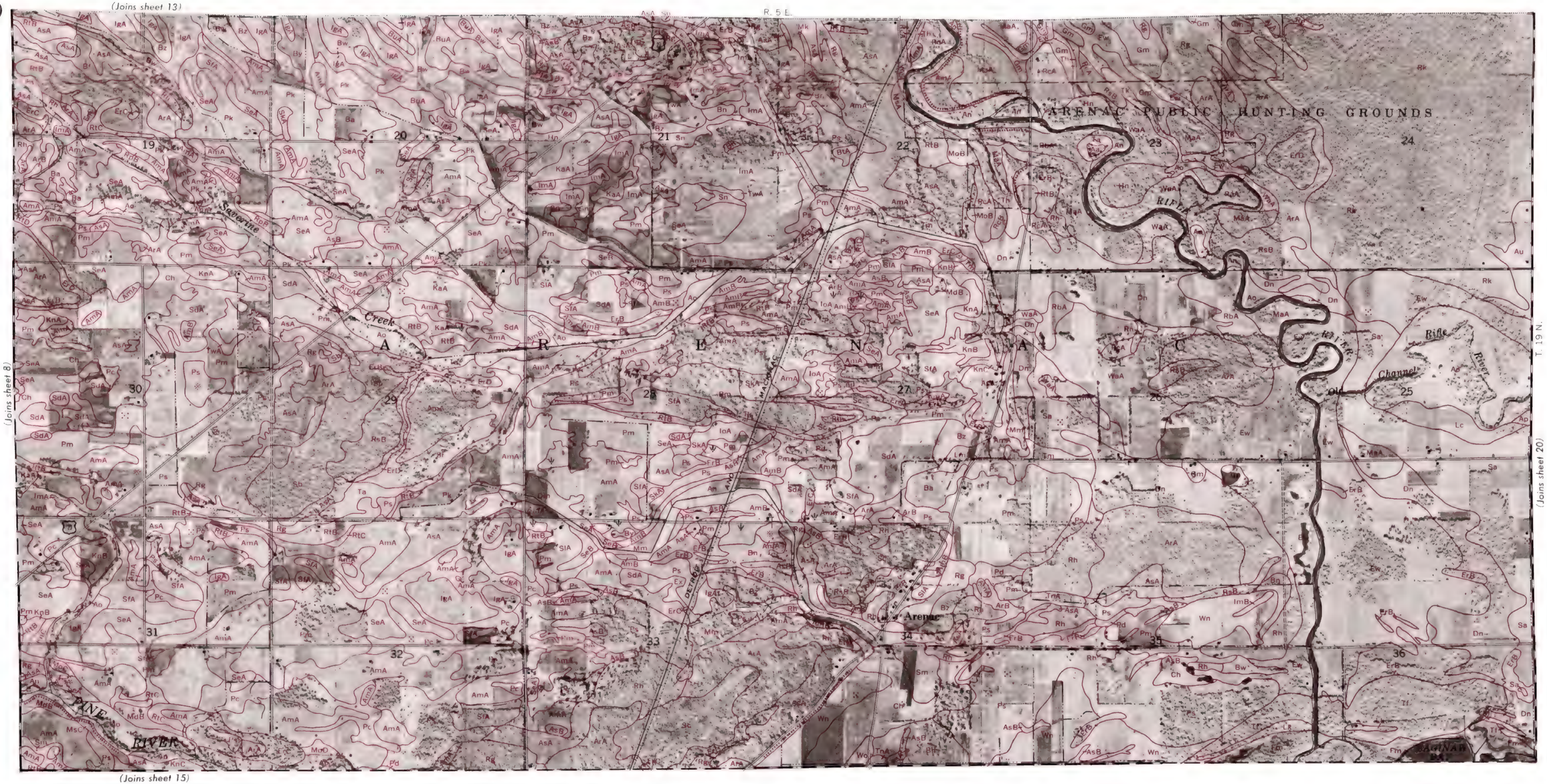
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Michigan Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.


12
(Joins sheet 11)
R 5 E
N
T. 20 N.
(Joins sheet 6)
(Joins sheet 18)
(Joins sheet 13)
TWINING
Big Creek Drain
Big Creek
MASON
ARENAC PUBLIC HUNTING GROUNDS
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet


R 5 E
(Joins sheet 12)
13
N
RIFLE RIVER
ARENAC
ARENAC PUBLIC HUNTING GROUNDS
OMER
DETROIT AND MACKINAC
MICHIGAN
EVERGREEN CEMETERY
(Joins sheet 7)
(Joins sheet 19)
(Joins sheet 14)
T 19 N
Range, township, and section corners shown on this map are indefinite.
0
1 Mile
Scale 1:20,000
5000 Feet

ARENAC COUNTY, MICHIGAN — SHEET NUMBER 14



This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture and the Michigan Agricultural Experiment Station

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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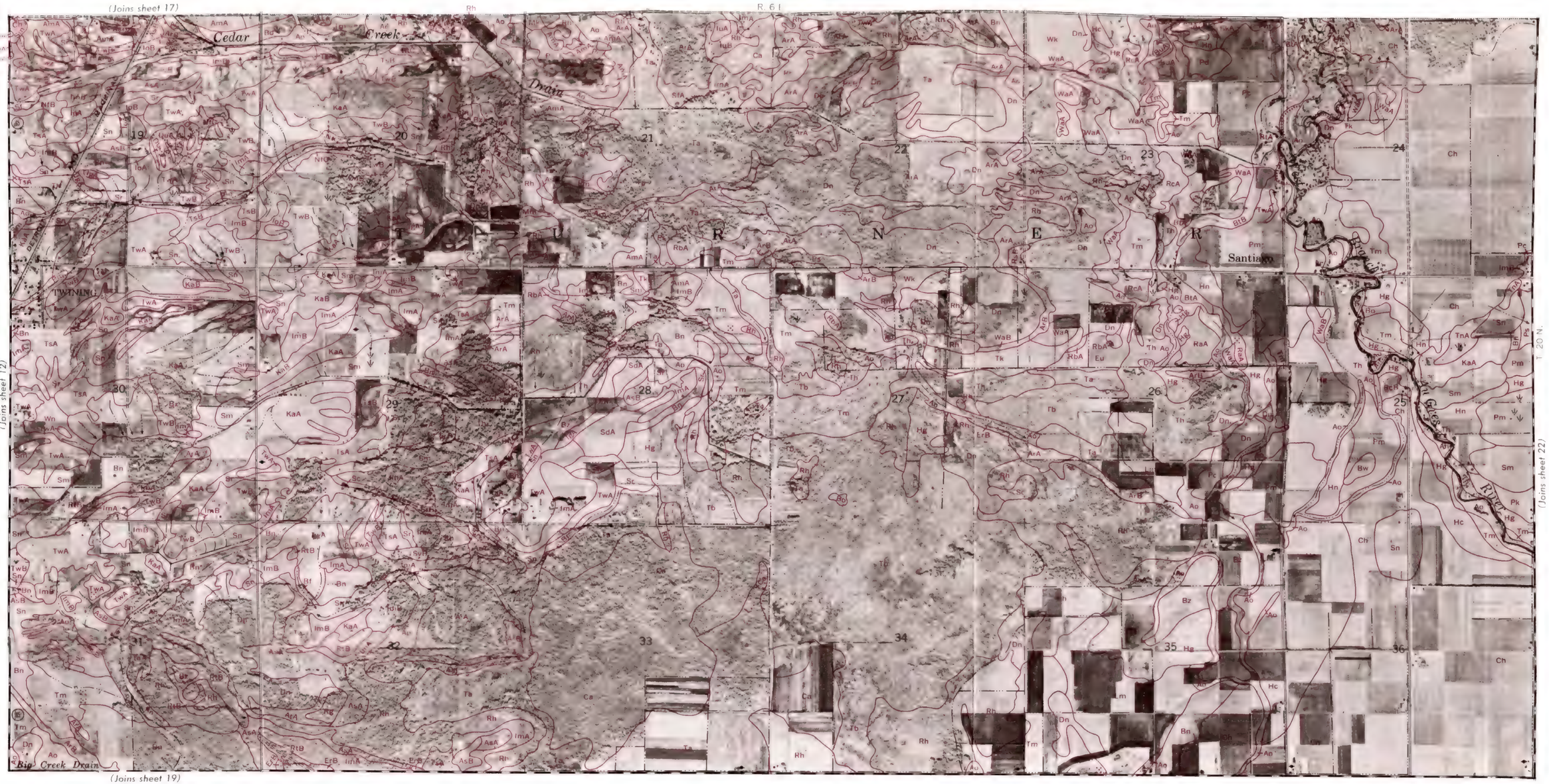
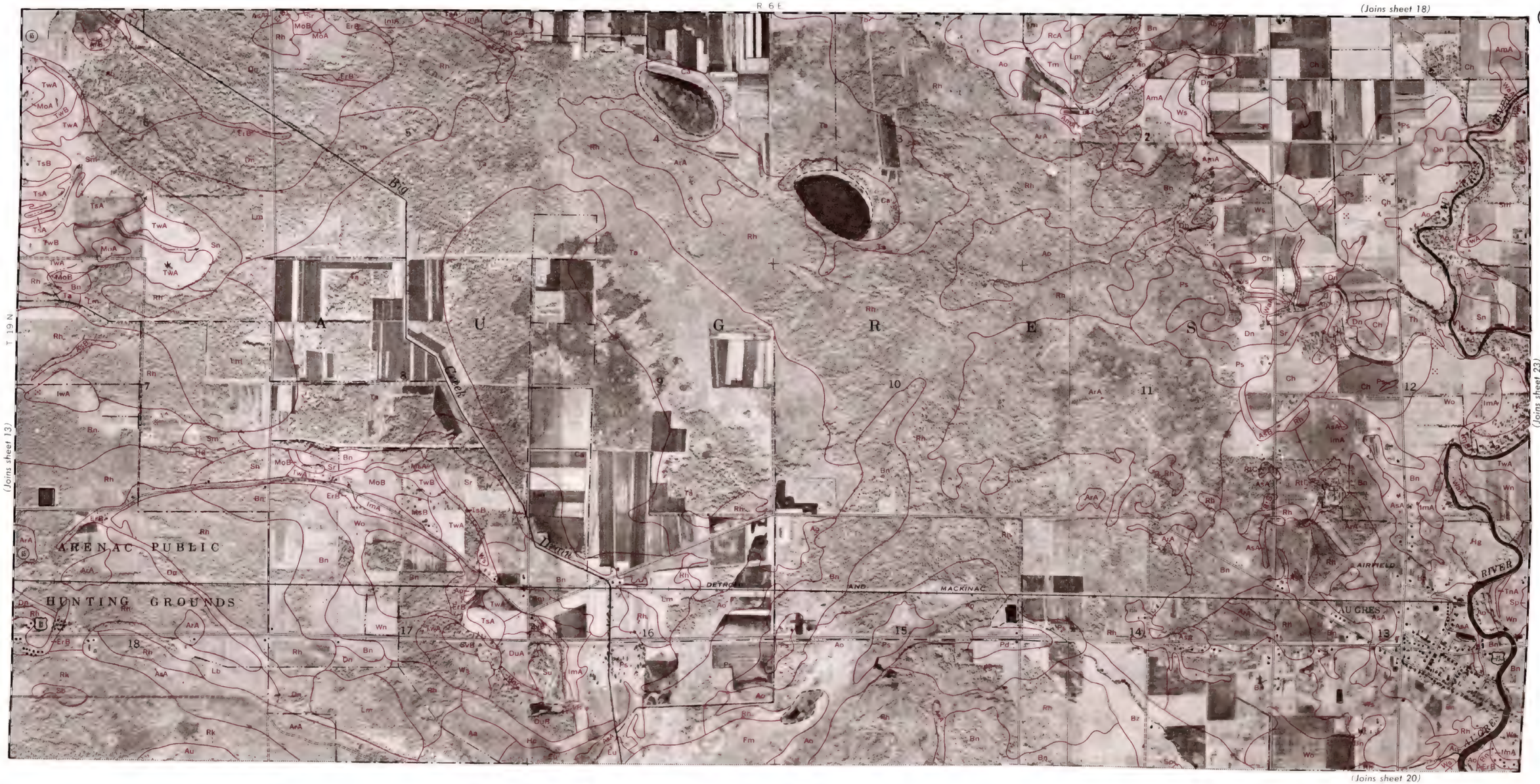
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

ARENAC COUNTY, MICHIGAN — SHEET NUMBER 18



0 ½ 1 Mile Scale 1:20,000 0 5000 Feet



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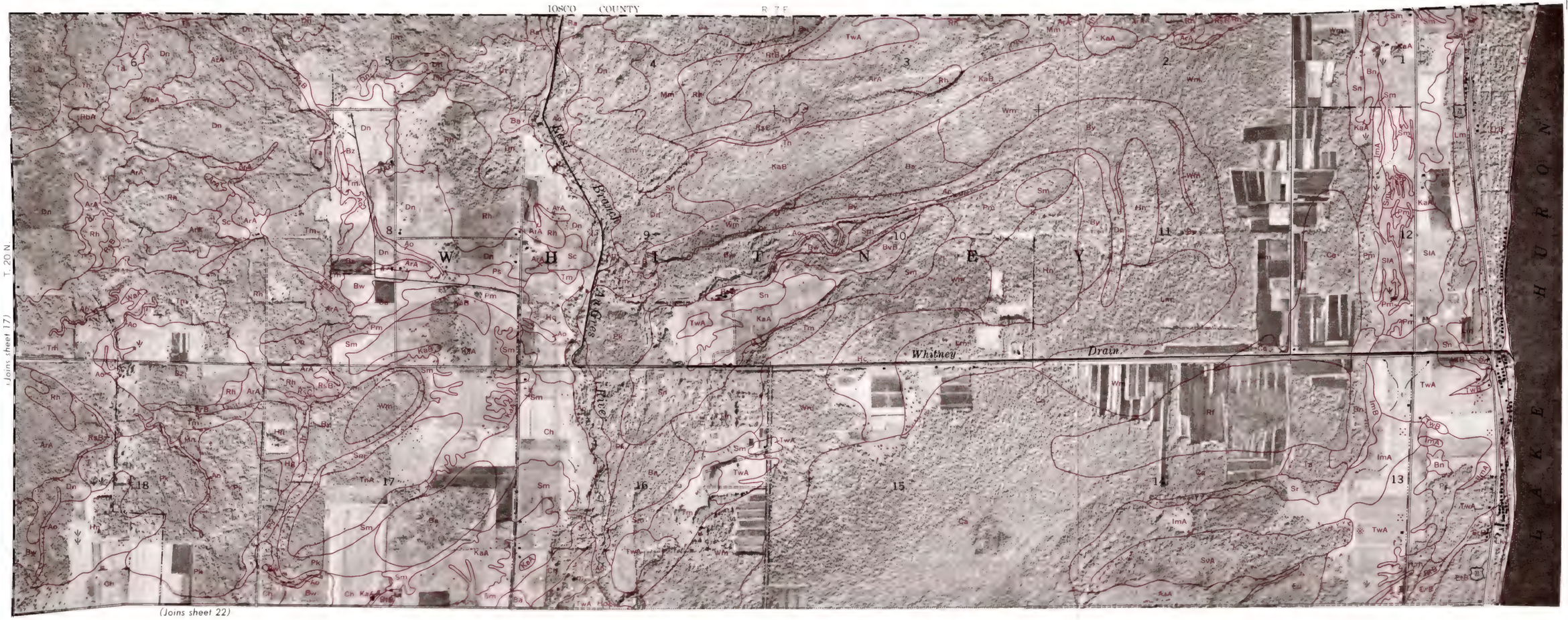
Range, township, and section corners shown on this map are indefinite


(Joins sheet 19)
R. 6 E.
ARENAC PUBLIC HUNTING GROUNDS
AU GRES RIVER
Big Creek Drain
Old Channel
Rifle River
SAGINAW BAY
(Joins sheet 14)
(Joins sheet 24)
T. 19 N.
(Joins upper inset, sheet 24)
(Joins lower inset, sheet 24)
Scale 1:20,000
1 Mile
5000 Feet



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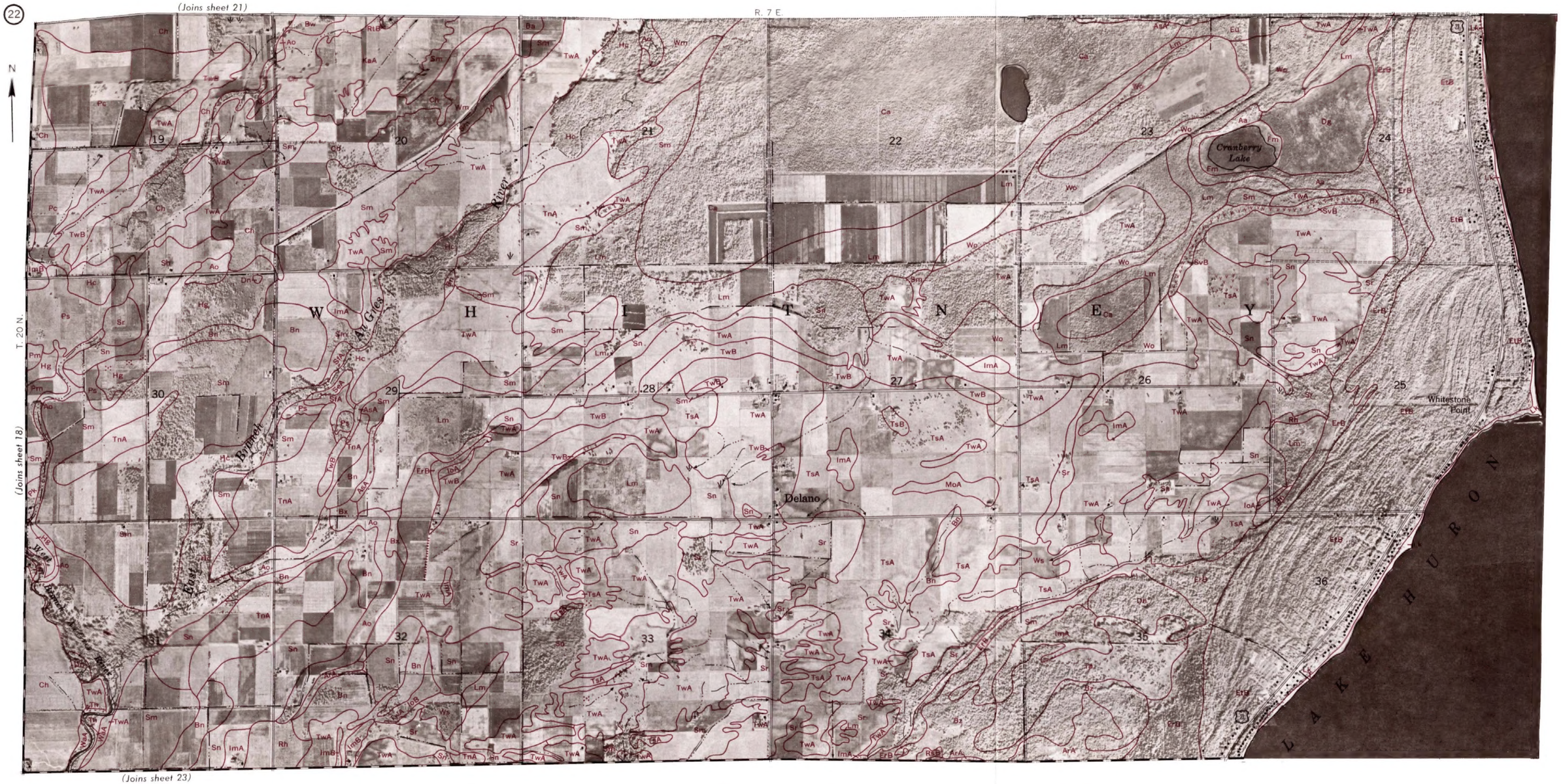
Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

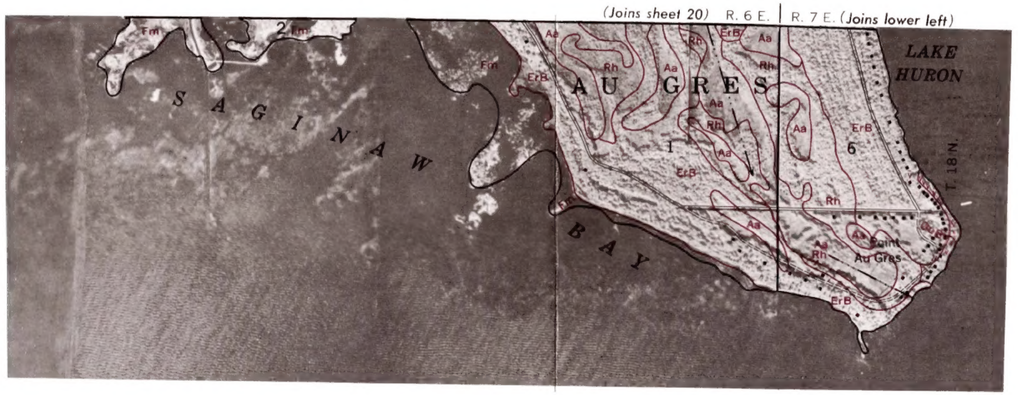

22
(Joins sheet 21)
R. 7 E.
N
T. 20 N.
(Joins sheet 18)
WHITNEY
Au Gres River
Bypaeh
Delano
Cranberry Lake
Whitestone Point
LAKE HURON
(Joins sheet 23)
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

ARENAC COUNTY, MICHIGAN — SHEET NUMBER 23

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Michigan Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

24



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

ARENAC COUNTY, MICHIGAN

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads

- Dual
- Good motor
- Poor motor
- Trail

Highway markers

- National Interstate
- U. S.
- State

Railroads

- Single track
- Multiple track
- Abandoned

Bridges and crossings

- Road
- Trail, foot
- Railroad
- Ferries
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings

- School
- Church
- Station

Mines and Quarries

Mine dump

Pits, gravel or other

Power lines

Pipe lines

Cemeteries

Dams

Levees

Tanks

Oil or gas wells

Forest fire or lookout station

BOUNDARIES

- National or state
- County
- Township, U. S.
- Section line, corner
- Reservation
- Land grant
- Township, civil

DRAINAGE

Streams

- Perennial
- Intermittent, unclass.

Canals and ditches — CANAL / DITCH

Lakes and ponds

- Perennial
- Intermittent

Wells — flowing

Springs

Marsh

Wet spot

Alluvial fan

Drainage ends

RELIEF

Escarpments

- Bedrock
- Other

Prominent peaks

Depressions

	Large	Small
Crossable with tillage implements		
Not crossable with tillage implements		
Contains water most of the time		

SOIL SURVEY DATA

Soil boundary and symbol — Dx

- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gullies